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Aerospace Medicine and Biology
A Continuing Bibliography with Indexes

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NASA SP-7011(329)

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 329)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in October 1989 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

National Aeronautics and Space Administration
Office of Management
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INTRODUCTION

This Supplement to *Aerospace Medicine and Biology* lists 184 reports, articles and other documents announced during October 1989 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA).* The first issue of the bibliography was published in July 1964.

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. In general, emphasis is placed on applied research, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the bibliography consists of a bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR,* including the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Seven indexes — subject, personal author, corporate source, foreign technology, contract, report number, and accession number — are included.

An annual index will be prepared at the end of the calendar year covering all documents listed in the 1989 Supplements.

Information on the availability of cited publications including addresses of organizations and NTIS price schedules is located at the back of this bibliography.

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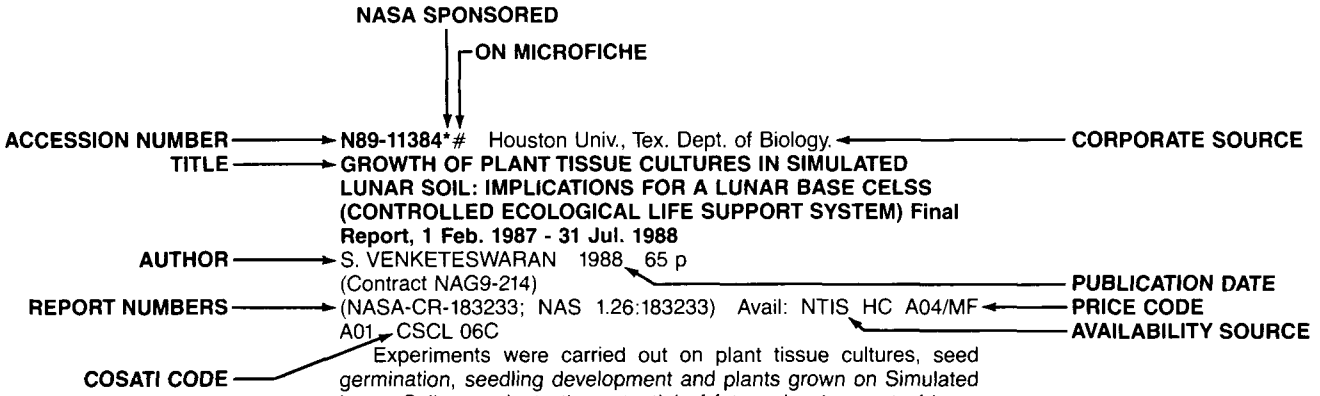
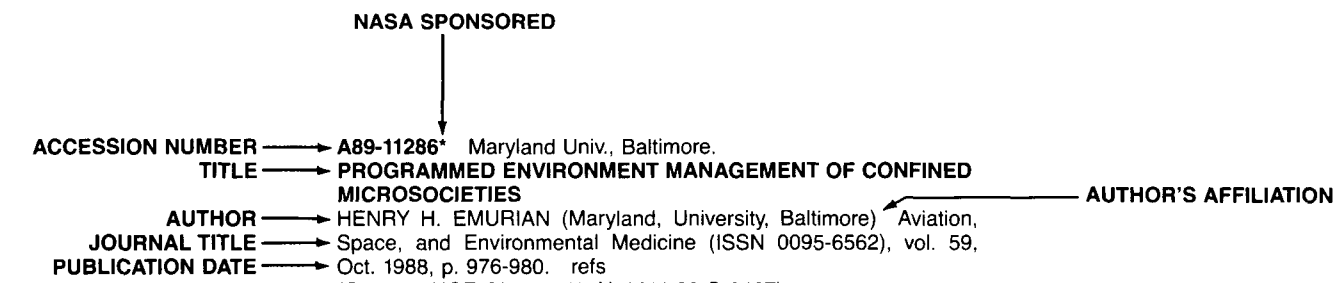
TYPICAL REPORT CITATION AND ABSTRACT



Experiments were carried out on plant tissue cultures, seed germination, seedling development and plants grown on Simulated Lunar Soil to evaluate the potential of future development of lunar based agriculture. The studies done to determine the effect of the placement of SLS on tissue cultures showed no adverse effect of SLS on tissue cultures. Although statistically insignificant, SLS in suspension showed a comparatively higher growth rate. Observations indicate the SLS, itself cannot support calli growth but was able to show a positive effect on growth rate of calli when supplemented with MS salts. This positive effect related to nutritive value of the SLS was found to have improved at high pH levels, than at the recommended low pH levels for standard media. Results from seed germination indicated that there is neither inhibitory, toxicity nor stimulatory effect of SLS, even though SLS contains high amounts of aluminum compounds compared to earth soil. Analysis of seeding development and growth data showed significant reduction in growth rate indicating that, SLS was a poor growth medium for plant life. This was confirmed by the studies done with embryos and direct plant growth on SLS. Further observations attributed this poor quality of SLS is due to it's lack of essential mineral elements needed for plant growth. By changing the pH of the soil, to more basic conditions, the quality of SLS for plant growth could be improved up to a significant level. Also it was found that the quality of SLS could be improved by almost twice, by external supply of major mineral elements, directly to SLS. Author

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT



A programmed environment is described that assists the implementation and management of schedules governing access to all resources and information potentially available to members of a confined microsociety. Living and work schedules are presented that were designed to build individual and group performance repertoires in support of study objectives and sustained adaptation by participants. A variety of measurement requirements can be programmed and standardized to assure continuous assessment of the status and health of a confined microsociety. Author

AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 329)

NOVEMBER 1989

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LIFE SCIENCES (GENERAL)

A89-43775
RADIOBIOLOGY OF HUMANS AND ANIMALS
SAMUEL P. IARMONENKO (AMN SSSR, Moscow, USSR) (Radiobiologiia cheloveka i zhivotnykh, Moscow, Izdatel'stvo Vysshaia Shkola, 1988) Moscow, Mir Publishers, 1988, 400 p. Translation. refs

The fundamentals and the application aspects of ionizing radiations are discussed. Attention is given to the radiation dose units, the concept of relative biological effectiveness, and factors affecting radiosensitivity. Direct and indirect biological effects of ionizing radiation in living organism and the mechanisms of these effects are examined. Consideration is given to radiation syndromes developing as a result of damage to the hemopoietic, gastro-intestinal, and central nervous systems, and to radiation sickness, recovery processes, the mechanisms of the late effects of irradiation, and the effects on the embryo and fetus. Also discussed are the biological effects of incorporated radionuclides, indirect effects of irradiation, and safety standards. Special attention is given to the methods used in therapy of acute radiation sickness and to chemical radiation protectors. I.S.

A89-44065
RNA-CATALYSED SYNTHESIS OF COMPLEMENTARY-STRAND RNA
JENNIFER A. DOUDNA and JACK W. SZOSTAK (Massachusetts General Hospital, Boston) Nature (ISSN 0028-0836), vol. 339, June 15, 1989, p. 519-522. refs

A self-replicating RNA or related polynucleotide is thought to be the key intermediate in the evolution of living systems from prebiotic chemicals. It is reported here that the ribozyme of the protozoan Tetrahymena can splice together multiple oligonucleotides aligned on a template strand to yield a fully complementary product strand. This reaction demonstrates the feasibility of RNA-catalyzed RNA replications. C.D.

A89-44075
THE MAXIMIZATION OF THE PRODUCTIVITY OF AQUATIC PLANTS FOR USE IN CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEMS (CELSS)
B. G. THOMPSON (Alberta Research Council, Edmonton, Canada) Acta Astronautica (ISSN 0094-5765), vol. 19, March 1989, p. 269-273. refs

Lemma minor (common duckweed) and a Wolffia sp. were grown in submerged growth systems. Submerged growth increased the productivity/unit volume of the organisms and may allow these plants to be used in a controlled ecological life support system. Author

A89-44184
THE RELEVANCE OF THE BACKGROUND IMPACT FLUX TO CYCLIC IMPACT/MASS EXTINCTION HYPOTHESES
MARTYN J. FOGG (London, University, England) Icarus (ISSN 0019-1035), vol. 79, June 1989, p. 382-395. refs

The question as to whether a background flux of random impacts may distort a hypothesized cycle of comet showers responsible for mass extinctions of species with a 26-33 million-year interval is presently addressed with a computer simulation of the impact-bombardment of the earth over a 250 million-year period in which the background impact flux is overlaid by a 26 million-year comet shower cycle. Mass extinction-data periodicity is obtained between 24 and 33 million years in about 40-60 percent of runs, dependent on the magnitude of the background flux chosen. Since only about 20-40 percent indicated 'true' 26-year periodicity, background impact noise is identifiable as yet another constraint on cyclic impact/mass extinction hypotheses. O.C.

A89-44501
COMETS AS A SOURCE OF PREFORMED MATERIAL FOR PREBIOTIC EVOLUTION
B. C. CLARK (Martin Marietta Planetary Sciences Laboratory, Denver, CO) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 2, 1989, p. 87-90. refs

Comets are known to contain ices, organic compounds, and silicate dust grains. During final accretion by the early earth, comets will have contributed chemical ingredients in several ways: as bulk additions to the volatile inventory; as particles, molecules, radicals, and atoms; and perhaps in rare cases as localized concentrated matter. Having originated in the outer solar system and/or interstellar space, these constituents are, not surprisingly, unique compared to those otherwise found at the surface of the early earth. Comets are apparently rich in materials that may be vital to successful prebiotic evolution, including light elements, catalytic elements, organic compounds, and microparticles of various types down to the submicrometer size range. Because of their exceptional chemical nature and great abundance, comets deserve serious consideration in models of accretion and early protobiological activity. Author

A89-44503
ORIGIN OF PRECURSORS OF ORGANIC MOLECULES DURING EVAPORATION OF METEORITES AND ROCKS
L. M. MUKHIN, M. V. GERASIMOV, and E. N. SAFONOVA (AN SSSR, Institut Kosmicheskikh Issledovanii, Moscow, USSR) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 2, 1989, p. 95-97. refs

The early earth's atmosphere and hydrosphere were formed in parallel with the earth's growth. The laser pulse effect on various rocks and meteorites was used to simulate the melting and evaporation processes of planetesimal matter caused by high-speed impact. The residual gas mixture contains both oxided and reduced components: CO, CO2, SO2, H2O, N2, in less quantities - H2S; COS; CS2, various hydrocarbons from C1 to C6. Such composition of atmosphere is favorable for the abiogenic synthesis rather than complex organic compounds. Direct formation of HCN and acetic aldehyde is especially significant in the experiment. Author

A89-44711
REGULATION OF INFRADIAN BIOLOGICAL RHYTHMS IN MAMMALS [REGULIATSIIA INFRADIANNYKH BIOLOGICHESKIKH RITMOV U MLEKOPITAIUSHCHIKH]

N. N. SHABATURA (Kievskii Gosudarstvennyi Pedagogicheskii Institut, Kiev, Ukrainian SSR) Kibernetika i Vychislitel'naia Tekhnika (ISSN 0454-9910), no. 78, 1988, p. 27-30. In Russian. refs

The mechanisms of regulation of infradian biological rhythms in mammals were investigated using data obtained on humans and rats on the parameters of cardiovascular and respiratory systems and energy exchange, and on body temperature and urine contents of adrenaline and noradrenaline. Rats were also analyzed for changes due to the activity of the hypothalamus-hypophyseal-suprarenal system by blocking various components of this system. Results showed that the physiological characteristics measured in both humans and rats varied with period lengths of either 5-7 days or 10-14 days. These infradian rhythms were found to be correlated with hormonal variations and were dependent on the intactness of the hypothalamus-hypophyseal-suprarenal system. I.S.

A89-44713
THE INDIVIDUAL CHARACTERISTICS OF MODULATION IN THE RHYTHMS OF GUINEA-PIG MASS FLUCTUATIONS DUE TO GEOPHYSICAL FACTORS [INDIVIDUAL'NYE OSOBENNOSTI MODULIATSII RITMOV IZMENENIIA MASSY MORSKIKH SVINOK GEOFIZICHESKIMI FAKTORAMI]
P. V. VASILIK, A. G. VASILEGA, and A. K. GALITSKII (AN USSR, Institut Kibernetiki, Kiev, Ukrainian SSR) Kibernetika i Vychislitel'naia Tekhnika (ISSN 0454-9910), no. 78, 1988, p. 82-90. In Russian. refs

Rhythmic modulations in an organism induced by changes in geophysical parameters were investigated by observing changes (within + or - 10 mg) in body mass of 20 guinea pigs during one year, starting from one month of the animals' age. The body-mass fluctuations, which were found to have a phase character, were correlated with the parameters of geomagnetic activity, solar activity, cosmic radiation, radio waves, and interplanetary magnetic field; relative humidity; total sedimentation; air temperature; and atmospheric pressure. It was found that the greatest effect on body mass is exerted by cosmic rays, which in turn are affected by solar activity. I.S.

A89-44714
THE PROBLEM OF BIOINFORMATIVE INTERACTIONS - THE MILLIMETER-WAVE RANGE [PROBLEMA BIOINFORMATSIONNYKH VZAIMODEISTVII: MILLIMETROVYI DIAPAZON DLIN VOLN]
N. D. KOLBUN and V. E. LOBAREV (Kievskii Gosudarstvennyi Universitet, Kiev, Ukrainian SSR) Kibernetika i Vychislitel'naia Tekhnika (ISSN 0454-9910), no. 78, 1988, p. 94-99. In Russian. refs

Experiments were conducted to demonstrate the effect of millimeter waves on sensory reactions of humans. Subjects were exposed to irradiation, in the area of an acupuncture zone, by waves of discrete wavelength ranges between 0.5 and 2.8 mm, and their sensory reactions were registered as a function of the wavelength range. It was found that the 1.8-2.0 mm range, i.e., the intensity close to the intensity of waves generated by living organisms, was most effective. The same wavelengths were found to be effective in increasing hemolytic activity by Proteus bacteria. I.S.

A89-44840
AUTOREGULATION AND THE DILATION RESERVE OF CORONARY VESSELS IN IMMOBILIZED RATS [AUTOREGULIATSIIA I RASSHIRITEL'NYI REZERV KORONARNYKH SOSUDOV U KRYS PRI OGRANICHENII IKH DVIGATEL'NOI AKTIVNOSTI]
A. P. BOZHKO and A. P. SOLODKOV (Vitebskii Meditsinskii Institut, Vitebsk, Belorussian SSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 75, April 1989, p. 522-528. In Russian. refs

The effect of immobilization stress on the parameters of autoregulation and the dilation reserve of coronary vessels was investigated in rats whose hearts were isolated after a 6-h-long period of enforced immobilization. Data were obtained on the contractile activity of the myocardium and the parameters of coronary autoregulation, determined as described by Novikova (1972). It was found that, as a result of immobilization, the ability of coronary vessels to resist the dilating effect of intravessel pressure declines, due to the fact that the correlation between the coronary flow and the contractile activity of the miocardium is disrupted. Immobilization stress seems to lower the basal tone of coronary vessels, thus leading to a superperfusion and a decline in coronary reserve. I.S.

A89-44841
ADAPTATION OF ANIMALS TO HYPOXIC-HYPERCAPNIC EFFECTS UNDER DESYMPATHIZATION [ADAPTATSIIA ZHIVOTNYKH K GIPOKSICHESKI-GIPERKAPNICHESKIM VOZDEISTVIIAM V USLOVIIAKH DESIMPATIZATSII]
N. I. MIKHALKINA and T. N. DANILEVSKAIA (AN KSSR, Institut Fiziologii, Alma-Ata, Kazakh SSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 75, April 1989, p. 562-566. In Russian. refs

The effect of pharmacological desympathization by reserpine injections (1 mg/kg once every 5 d) on the morphometric parameters of the rat miocardium during adaptation to hypoxic (partial vacuum for 1.5 h daily) and hypoxic-hypercapnic conditions was investigated using the method of Schwarts et al. (1980) to estimate the extent of cardiac hypertrophy. It was found that exposures to hypoxia (or hypoxia combined with hypercapnia) for 7 days leads to significant myocardial hypertrophy, the extent of which diminishes in intact animals after adaptation (30-d exposures). Desympathization by reserpine injections was found to disturb the adaptive process, leading to more pronounced myocardial hypertrophy, in comparison with intact animals. I.S.

A89-44842
THERMOPHYSICAL MODEL OF THERMOREGULATION IN RABBITS [TEPLOFIZICHESKAIA MODEL' TERMOREGULIATSII KROLIKA]
G. V. RUMIANTSEV and G. B. MOROZOV (AN SSSR, Institut Fiziologii, Leningrad, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 75, April 1989, p. 595-598. In Russian.

The thermophysical model of Rumiantsev and Morozov (1988) of heat regulating processes in rabbits is described. The model takes into account the processes of heat production and heat emission that occur in vivo under normal conditions and during changes in thermal environment and metabolism, and includes major mechanisms of the origin of thermoregulatory reactions in the rabbit body. Results are presented on the reactions of the model to sudden drops and elevations as well as to gradual decreases and rises in the ambient temperature. I.S.

A89-45232* *California Univ., San Francisco.*
PROJECTIONS FROM THE ROSTRAL MESENCEPHALIC RETICULAR FORMATION TO THE SPINAL CORD - AN HRP AND AUTORADIOGRAPHICAL TRACING STUDY IN THE CAT
G. HOLSTEGE (California, University, San Francisco) and R. J. COWIE (Howard University, Washington, DC) Experimental Brain Research (ISSN 0014-4819), vol. 75, 1989, p. 265-279. Research supported by Howard University. refs
(Contract NCC2-491)

Horseradish peroxidase was injected, or implanted unilaterally, into various levels of the spinal cord of anesthetized cats, to trace the distribution of projections to the spinal cord, of neurons in Field H of Forel, including the rostral interstitial nucleus of the medial longitudinal fasciculus (riMLF), and the interstitial nucleus of Cajal with adjacent reticular formation (INC-RF). Results indicate that, unlike the neurons projecting to the extraocular muscle motoneurons, the major portion of the spinally projecting neurons are not located in the riMLF or INC proper, but in adjacent areas, i.e., the ventral and lateral parts of the caudal third of the Field H of Forel and in the INC-RF. Neurons in caudal Field H of Forel, project, via the ventral part of the ventral funicululs, to the lateral part of the upper cervical ventral horn. I.S.

A89-45235* Wright State Univ., Dayton, OH.
CEREBROSPINAL FLUID CONSTITUENTS OF CAT VARY WITH SUSCEPTIBILITY TO MOTION SICKNESS
JAMES B. LUCOT, GEORGE H. CRAMPTON (Wright State University, Dayton, OH), WAYNE R. MATSON, and PAUL H. GAMACHE (ESA, Inc., Bedford, MA) Life Sciences (ISSN 0024-3205), vol. 44, no. 18, 1989, p. 1239-1245. refs
(Contract NCC2-220)

The cerebrospinal fluid drawn from the fourth ventricles of the brains of cats during and after the development of motion sickness was studied to determine what neurotransmitters may be involved in the development of the sickness. The analytical procedure, which uses HPLC coupled with n-electrode coulometric electrochemical detection to measure many compounds with picogram sensitivity, is described. Baseline levels of DOPAC, MHPGSO4, uric acid, DA, 5-HIAA, and HVA were lower on motion and control days in cats which became motion sick when compared with cats which did not. None of the total of 36 identified compounds identified in the samples varied as a function of either exposure to motion or provocation of emesis. It is concluded that susceptibility to motion sickness is a manifestation of individual differences related to fundamental neurochemical composition. C.D.

A89-45253* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CARBON ISOTOPIC TRENDS IN THE HYPERSALINE PONDS AND MICROBIAL MATS AT GUERRERO NEGRO, BAJA CALIFORNIA SUR, MEXICO - IMPLICATIONS FOR PRECAMBRIAN STROMATOLITES
DAVID J. DES MARAIS, HOA NGUYEN, MICHAEL CHEATHAM, TERRI CHEATHAM, ELAINE MUNOZ (NASA, Ames Research Center, Moffett Field, CA), and YEHUDA COHEN (Jerusalem, Hebrew University, Israel) IN: Microbial mats: Physiological ecology of benthic microbial communities. Washington, DC, American Society for Microbiology, 1989, p. 191-203. Research supported by NASA. refs

A89-45254* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COMPARATIVE FUNCTIONAL ULTRASTRUCTURE OF TWO HYPERSALINE SUBMERGED CYANOBACTERIAL MATS - GUERRERO NEGRO, BAJA CALIFORNIA SUR, MEXICO, AND SOLAR LAKE, SINAI, EGYPT
ELISA D'ANTONI D'AMELIO, DAVID J. DES MARAIS (NASA, Ames Research Center, Moffett Field, CA), and JEHUDA COHEN (Jerusalem, Hebrew University, Israel) IN: Microbial mats: Physiological ecology of benthic microbial communities. Washington, DC, American Society for Microbiology, 1989, p. 97-113. refs

The ultrastructure of the submerged microbial mat from the Solar Lake (SL), Egypt, was compared to that of samples from the Guerrero Negro (GN), Mexico, salt pans. The locations and distributions of the main organisms were determined light microscopy, and the corresponding ultrathin sections were examined under TEM; chemical microprofile analyses were carried out on the day of sampling for microscopic studies. Both communities were found to be dominated by Microleus chthonoplastes, although several morphological species found in the GN mat were absent from the SL mat, including the Tropica nigra and the 'big' Microleus chthonoplastes component. The chemical microprofiles of oxygen, sulfide, pH, and the oxygenic photosynthesis in the two mats were virtually identical. In both mats, the photic zone was restricted to the upper 800 microns of the mat, and oxygenic photosynthesis was detected down to 600 microns. I.S.

A89-46125
FREEZE AVOIDANCE IN A MAMMAL - BODY TEMPERATURES BELOW 0 C IN AN ARCTIC HIBERNATOR
BRIAN M. BARNES (Alaska, University, Fairbanks) Science (ISSN 0036-8075), vol. 244, June 30, 1989, p. 1593-1595. refs
(Contract NIH-HD-23383)

Hibernating arctic ground squirrels, Spermophilus parryii, were able to adopt and spontaneously arouse from core body temperatures as low as -2.9 C without freezing. Abdominal body temperatures of ground squirrels hibernating in outdoor burrows were recorded with temperature-sensitive radiotransmitter implants. Body temperatures and soil temperatures at hibernaculum depth reached average minima during February of -1.9 and -6 C, respectively. Laboratory-housed ground squirrels hibernating in ambient temperatures of -4.3 C maintained above 0 C thoracic temperatures but decreased colonic temperatures to as low as -1.3 C. Plasma sampled from animals with below 0 C body temperatures had normal solute concentrations and showed no evidence of containing antifreeze molecules. Author

A89-46200
NONIONIZING ELECTROMAGNETIC RADIATIONS AND ULTRASOUND
Bethesda, MD, National Council on Radiation Protection and Measurements, 1988, 390 p. No individual items are abstracted in this volume.

The biological effects of nonionizing EM radiation and ultrasound are discussed in reviews and reports presented at the 22nd annual meeting of the National Council on Radiation Protection and Measurements, held in Washington, DC, on April 2-3, 1986. Topics addressed include the physical and behavioral effects of RF fields, LF electrical fields, and magnetic fields; medical ultrasound; and its possible side effects. Also included are reports from the Council's scientific committees and an ad hoc group on video display terminals. T.K.

A89-46395
HYPERBOLIC DEPENDENCE OF NEUROELECTRIC EFFECTS IN THE CEREBRAL FORM OF RADIATION INJURY [GIPERBOLICHESKAIA ZAVISIMOST' NEIROELEKTRICHESKIKH EFFEKTOV PRI TSEREBRAL'NOI FORME LUCHEVYKH PORAZHENII]
V. N. KARPOV, B. I. DAVYDOV, and I. B. USHAKOV Radiobiologiia (ISSN 0033-8192), vol. 29, Mar.-Apr. 1989, p. 171-174. In Russian. refs

A89-46396
RADIOPROTECTIVE EFFECT OF LONG-TERM ANOXIA ON MEMBRANE LIPIDS OF IRRADIATED TURTLES [RADIOPROTEKTORNOE DEISTVIE DLITEL'NOI ANOKSII NA MEMBRANNYE LIPIDY OBLUCHENNYKH CHEREPAKH]
V. I. IVANOV and A. A. TURDYEV (AN USSR, Institut Biokhimii, Tashkent, Uzbek SSR) Radiobiologiia (ISSN 0033-8192), vol. 29, Mar.-Apr. 1989, p. 215-220. In Russian. refs

A89-46397
QUANTITATIVE HISTOLOGICAL CHANGES OF THE GLIONEURONAL COMPLEX IN THE CENTRAL AND INTERSTITIAL REGIONS OF THE VISUAL ANALYZER UNDER THE EFFECT OF MICOWAVES OF THERMOGENIC INTENSITY [GISTOKOLICHESTVENNYE IZMENENIIA GLIONEIRONAL'NOGO KOMPLEKSA V TSENTRAL'NOM I PROMEZHUTOCHNOM OTDELAKH ZRITEL'NOGO ANALIZATORA PRI VOZDEISTVII MIKROVOLN TERMOGENNOI INTENSIVNOSTI]
S. V. LOGVINOV (Tomskii Gosudarstvennyi Meditsinskii Institut, Tomsk, USSR) Radiobiologiia (ISSN 0033-8192), vol. 29, Mar.-Apr. 1989, p. 247-250. In Russian. refs

A89-46398
SOME CHARACTERISTICS OF THE HEMOPOIETIC STEM CELLS OF MICE IN THE STAGE OF ENHANCED RADIORESISTANCE FOLLOWING SUBLETHAL IRRADIATION [NEKOTORYE KHARAKTERISTIKI STVOLOVYKH KROVETVORNYKH KLETOK MYSHEI V FAZE POVYSHENNOI RADIOREZISTENTNOSTI POSLE SUBLETAL'NOGO OBLUCHENIIA]
N. V. BUTOMO and V. B. IVANOV (Voenno-Meditsinskaia Akademiia, Leningrad, USSR) Radiobiologiia (ISSN 0033-8192), vol. 29, Mar.-Apr. 1989, p. 266-268. In Russian. refs

A89-46555
THE IMMUNE SYSTEM IN EXTREME CONDITIONS. SPACE IMMUNOLOGY [SISTEMA IMMUNITETA V EKSTREMAL'NYKH USLOVIIAKH: KOSMICHESKAIA IMMUNOLOGIIA]
IRINA V. KONSTANTINOVA Moscow, Izdatel'stvo Nauka (Problemy Kosmicheskoi Biologii. Volume 59), 1988, 288 p. In Russian. refs

Changes in the parameters of the immune system induced by the conditions of space flight are examined together with the characteristics that indicate adaptation to these conditions. The general characteristics of the immune-cell populations are described, together with the features of the humoral and neuroendocrinal regulation of immune response and the methods used in the immune-system activity studies. Special consideration is given to the effects of long-term space flights on the components of the immune system and the effects of particular conditions specific to space flights. Results are presented on animals and cultured cells used in space flights. Problems related to Ca metabolism in bone tissue are discussed together with methods used to counteract the effects of hypogravity and hypokinesia on cellular metabolism (including the use of oligonucleotides and activators of immunocyte activity). I.S.

A89-47420* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THERMOREGULATION IN HYPERGRAVITY-ACCLIMATED RATS
CONRAD B. MONSON, SUSAN L. PATTERSON, JOHN M. HOROWITZ, and JIRO OYAMA (NASA, Ames Research Center, Moffett Field, CA; California, University, Davis) Journal of Applied Physiology (ISSN 0161-7567), vol. 67, July 1989, p. 383-389. refs
(Contract NAGW-1458)

The effect of acclimation to hypergravity on thermoregulatory responses of rats was determined by comparing data on core temperature, T(c), tail temperature, and O2 consumption in rats raised at 1 G (C) and at 2.1 G. It was found that, when C rats were exposed to an ambient temperature of 9 C concurrently with exposure to 2.1 G, the T(c) fell by about 6 C, while in rats acclimated to 2.1 G, the T(c) fell only by 1 C. Results of O2 consumption measurements showed that C rats exposed simultaneously to cold and hypergravity were not activating their thermogenic mechanism sufficiently to prevent a fall in T(c). In other experiments, rats acclimated to either 1 or 2.1 G were found to lack the ability to maintain their T(c) when exposed to a 5.8-G field or when cold-stressed at 1 G for extended times. I.S.

N89-25556*# Lockheed Engineering and Sciences Co., Washington, DC.
USSR SPACE LIFE SCIENCES DIGEST. INDEX TO ISSUES 15-20
LYDIA RAZRAN HOOKE, ed. Washington NASA Apr. 1989 151 p
(Contract NASW-4292)
(NASA-CR-3922(25); NAS 1.26:3922(25)) Avail: NTIS HC A08/MF A01 CSCL 06C

This bibliography provides an index to issues 15 through 20 of the USSR Space Life Sciences Digest. There are two sections. The first section lists bibliographic citations of abstracts in these issues, grouped by topic area categories. The second section provides a key word index for the same abstracts. The topic categories include exobiology, space medicine and psychology, human performance and man-machine systems, various life/body systems, human behavior and adaptation, biospherics, and others. Author

N89-25557*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPIRAL VANE BIOREACTOR Patent Application
DENNIS R. MORRISON, inventor (to NASA) 29 Nov. 1988 30 p Sponsored by NASA. Johnson Space Center
(NASA-CASE-MSC-21361-1; NAS 1.71:MSC-21361-1; US-PATENT-APPL-SN-278137) Avail: NTIS HC A03/MF A01 CSCL 06C

A spiral vane bioreactor of a perfusion type is descibed in which a vertical chamber, intended for use in a microgravity condition, has a central rotating filter assembly and has flexible membranes disposed to rotate annularly about the filter assembly. The flexible members have end portions disposed angularly with respect to one another. A fluid replenishment medium is input from a closed loop liquid system to a completely liquid filled chamber containing microcarrier beads, cells and a fluid medium. Output of spent medium is to the closed loop. In the closed loop, the output and input parameters are sensed by sensors. A manifold permits recharging of the nutrients and pH adjustment. Oxygen is supplied and carbon dioxide and bubbles are removed and the system is monitored and controlled by a microprocessor. NASA

N89-25558*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ACCLIMATIZATION TO HEAT IN HUMANS
JOHN E. GREENLEAF and HANNA KACIUBA-USCILKO (Polish Academy of Sciences, Warsaw.) Apr. 1989 45 p
(NASA-TM-101011; A-88222; NAS 1.15:101011) Avail: NTIS HC A03/MF A01 CSCL 06C

The responses and mechanisms of both natural and artificial acclimatization to a hot environment in mammals are addressed with specific reference to humans. The purpose is to provide basic information for designers of thermal protection systems and countermeasures for astronauts during intra- and extravehicular activity. Areas covered are energy metabolism, thermal balance at rest and during exercise, water and electrolyte balance during exercise and immobilization, and heat diseases. Author

N89-25559# Harvard Univ., Cambridge, MA. Dept. of Cellular and Developmental Biology.
UNRAVELING PHOTOSYSTEM 2 Progress Report, 1 Feb. 1988 - 31 Jan. 1989
LAWRENCE BOGORAD 1989 4 p
(Contract DE-FG02-87ER-13743)
(DE89-010930; DOE/ER-13743/2) Avail: NTIS HC A02/MF A01

This project identifies and characterizes protein components of the energy-transducing reaction centers in photosynthetic membranes to understand how these components are arranged and function in the membrane. One question involves whether open reading frames found in chloroplast DNA sequences in fact encode proteins of the photosynthetic apparatus and, if so, to determine where the proteins function. A new protein subunit of the cytochrome b6/f electron transport complex has been identified in the course of this work. Another approach to identifying, characterizing and establishing the role of proteins of the photosynthetic apparatus has been to generate photosynthetic mutants of the facultatively heterotrophic single-celled cyanobacterium Synechocystis PCC6803 and then to identify DNA sequences that correct the mutant phenotype. Cyanobacteria are relatively simple organisms that carry out the same type of oxygen-evolving photosynthesis as chloroplasts of higher green plants but they are more convenient for certain experiments. Mutants studied to date in this part of the program have had deficiencies in chlorophyll-proteins associated with the reaction center of Photosystem 2. Such mutants have been very useful in revealing the sources of certain fluorescence emission bands in the photosynthetic apparatus and thus helping understand the transfer of energy within these systems. Sets of mutants with other genetic lesions are being analyzed. DOE

N89-25560# Cornell Univ., Ithaca, NY.
EFFECTS OF FREEZING AND COLD ACCLIMATION ON THE PLASMA MEMBRANE OF ISOLATED PROTOPLASTS Progress Report, 16 May 1988 - 9 Jan. 1989
1989 7 p
(Contract DE-FG02-84ER-13214)
(DE89-010931; DOE/ER-13214/3) Avail: NTIS HC A02

The emphasis of this project is on the form of injury referred to as loss of osmotic responsiveness (LOR). Our goals are to

provide a mechanistic understanding of freeze/dehydration-induced mesomorphic phase transitions in the plasma membrane that are manifested as alterations in the ultrastructure (lateral phase separations, a particulate lamellae, and hexagonal configurations) and which result in the loss of osmotic reponsiveness of NA protoplasts and to determine the cellular and molecular mechanisms by which cold acclimation and cryoprotectants preclude or diminish these alterations in the plasma membrane of ACC protoplasts. As a working hypothesis, we propose that the alterations in the ultrastructure of the plasma membrane of NA protoplasts that are responsible for LOR are a consequence of lipid demixing that occurs as a result of the close approach of bilayers during freeze-induced dehydration. Normally the close approach of two bilayers is precluded because of the large repulsive forces (hydration forces) resulting from the strong affinity of the hydrophilic surfaces for water. However, large osmotic potentials occur during the freezing of aqueous solutions and are of sufficient magnitude to overcome the hydration forces. Theory predicts that large lateral pressures will occur during the resultant close approach of the bilayers and will result in phase separation of the bilayer components. The fact that lateral phase separations and hexagonal phases are not observed in ACC protoplasts subjected to freeze-induced dehydration indicates that cold acclimation decreases the propensity to undergo demixing and lateral segregation of the membrane components. Our working hypothesis is that this is, in part, a consequence of alterations in the lipid composition of the plasma membrane and possibly the increased cytoplasmic concentrations of solutes such as sucrose and proline. DOE

N89-25561*# Alabama A & M Univ., Normal.
CHARACTERIZATION OF SPIRULINA BIOMASS FOR CELSS DIET POTENTIAL
MAHASIN G. TADROS Oct. 1988 53 p
(Contract NCC2-501)
(NASA-CR-185329; NAS 1.26:185329) Avail: NTIS HC A04/MF A01 CSCL 06C

Spirulina sp. as a bioregenerative photosynthetic and an edible alga for space craft crew in a CELSS, was characterized for growth rate and biomass yield in batch cultures, under various environmental conditions. The cell characteristics were identified for two strains of Spirulina: S. maxima and S. plantensis. Fast growth rate and high yield of both strains were obtained under the following conditions: temperature (30 to 35 C), light irradiance (60 to 100 uE/m/s), nitrate (30 mM), phosphate (2 mM), aeration (300 ml/min), and ph (9 to 10). The partitioning of the assimalatory products (proteins, carbohydrates, lipids) were manipulated by varying the environmental growth conditions. The experiments with Spirulina demonstrated that under stress conditions (high light 120 uE/m/s, temperature 38 C, nitrogen or phosphate limitation; 0.1 M sodium chloride) carbohydrate increased at the expense of protein. In other experiments, where the growth media were sufficient in nutrients and incubated under optimum growth conditions, the total proteins were increased up to almost 70 percent of the organic weight. Conclusion: The nutritional quality of the alga could be manipulated by growth conditions, and therefore usful as a subsystem in CELSS. Author

N89-25562# Nebraska Univ., Lincoln. Dept. of Chemistry.
ELECTROCHEMICAL AND OPTICAL STUDIES OF MODEL PHOTOSYNTHETIC SYSTEMS Progress Report, 1 Jul. 1988 - 30 Jun. 1989
THERESE M. COTTON 20 Feb. 1989 10 p
(Contract DE-FG02-84ER-13261)
(DE89-012479; DOE/ER-13261/5) Avail: NTIS HC A02/MF A01

During the initial eight months of this funding period, we continued studies of photosynthetic model systems with the study of spread monolayers, monolayers transferred to solid supports by the Langmuir-Blodgett technique, self-assembled monolayers, and vesicle systems. The principle instrumental methods of characterization remained electrochemical techniques and optical methods (resonance Raman, UV-VIS and surface enhanced resonance Raman scattering (SERS) spectroscopy). Specific compounds of interest comprised chlorophylls, porphyrins, synthetic redox-active species and protein/peptide systems. DOE

N89-26334*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EXOBIOLOGY AND FUTURE MARS MISSIONS
CHRISTOPHER P. MCKAY, ed. and WANDA DAVIS, L., ed. Washington Mar. 1989 73 p Workshop held in Sunnyvale, CA, Mar. 1988
(NASA-CP-10027; A-89098; NAS 1.55:10027) Avail: NTIS HC A04/MF A01 CSCL 03/2

Scientific questions associated with exobiology on Mars were considered and how these questions should be addressed on future Mars missions was determined. The mission that provided a focus for discussions was the Mars Rover/Sample Return Mission.

N89-26335*# California Univ., Santa Barbara. Dept. of Geological Sciences.
EARTH'S EARLY FOSSIL RECORD: WHY NOT LOOK FOR SIMILAR FOSSILS ON MARS?
STANLEY M. AWRAMIK *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 4-5 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

The oldest evidence of life on Earth is discussed with attention being given to the structure and formation of stromatolites and microfossils. Fossilization of microbes in calcium carbonate or chert media is discussed. In searching for fossil remains on Mars, some lessons learned from the study of Earth's earliest fossil record can be applied. Certain sedimentary rock types and sedimentary rock configurations should be targeted for investigation and returned by the Martian rover and ultimately by human explorers. Domical, columnar to wavy laminated stratiform sedimentary rocks that resemble stromatolites should be actively sought. Limestone, other carbonates, and chert are the favored lithology. Being macroscopic, stromatolites might be recognized by an intelligent unmanned rover. In addition, black, waxy chert with conchoidal fracture should be sought. Chert is by far the preferred lithology for the preservation of microbes and chemical fossils. Even under optimal geological conditions (little or no metamorphism or tectonic alteration, excellent outcrops, and good black chert) and using experienced field biogeologists, the chances of finding well preserved microbial remains in chert are very low. A.D.

N89-26339*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANALYTICAL ELECTRON MICROSCOPY OF BIOGENIC AND INORGANIC CARBONATES Abstract Only
DAVID F. BLAKE *In its* Exobiology and Future Mars Missions p 10 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

In the terrestrial sedimentary environment, the mineralogically predominant carbonates are calcite-type minerals (rhombohedral carbonates) and aragonite-type minerals (orthorhombic carbonates). Most common minerals precipitating either inorganically or biogenically are high magnesium calcite and aragonite. High magnesium calcite (with magnesium carbonate substituting for more than 7 mole percent of the calcium carbonate) is stable only at temperatures greater than 700 C or thereabouts, and aragonite is stable only at pressures exceeding several kilobars of confining pressure. Therefore, these carbonates are expected to undergo chemical stabilization in the diagenetic environment to ultimately form stable calcite and dolomite. Because of the strong organic control of carbonate deposition in organisms during biomineralization, the microchemistry and microstructure of invertebrate skeletal material is much different than that present in inorganic carbonate cements. The style of preservation of microstructural features in skeletal material is therefore often quite distinctive when compared to that of inorganic carbonate even though wholesale recrystallization of the sediment has taken place. Microstructural and microchemical comparisons are made between high magnesium calcite echinoderm skeletal material and modern

inorganic high magnesium calcite inorganic cements, using analytical electron microscopy and related techniques. Similar comparisons are made between analogous materials which have undergone stabilization in the diagenetic environment. Similar analysis schemes may prove useful in distinguishing between biogenic and inorganic carbonates in returned Martian carbonate samples. Author

N89-26342*# California Univ., Davis. Dept. of Zoology.
LIFE WITHOUT WATER Abstract Only
LOIS M. CROWE and JOHN H. CROWE *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 13-14 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

Anhydrobiosis, or life without water is commonly demonstrated by a number of plants and animals. These organisms have the capacity to loose all body water, remain dry for various periods, and then be revived by rehydration. While in the anhydrobiotic state, these organisms become highly resistant to several environmental stresses such as extremely low temperatures, elevated temperatures, ionizing radiation, and high vacuum. Since water is commonly thought to be essential for life, survival of anhydrobiotic organisms with an almost total loss of water is examined. A search of literature reveal that many anhydrobiotic organisms make large quantities of trehalose or other carbohydrates. Laboratory experiments have shown that trehalose is able to stabilize and preserve microsomes of sarcoplasmic reticulum and artificial liposomes. It was demonstrated that trehalose and other disaccharides can interact directly with phosopipid headgroups and maintain membranes in their native configuration by replacing water in the headgroup region. Recent studies show that trehalose is an effective stabilizer of proteins during drying and that it does so by direct interaction with groups on the protein. If life that is able to withstand environmental extremes has ever developed on Mars, it is expected that such life would have developed some protective compounds which can stabilize macromolecular structure in the absence of water and at cold temperatures. On Earth, that role appears to be filled by carbohydrates that can stabilize both membrane and protein stuctures during freezing and drying. By analog with terrestrial systems, such life forms might develop resistance either during some reproductive stage or at any time during adult existence. If the resistant form is a developmental stage, the life cycle of the organism must be completed with a reasonable time period relative to time when environmental conditions are favorable. This would suggest that simple organisms with a short life cycle might be most sucessful. Author

N89-26343*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
STABLE CARBON AND SULFUR ISOTOPES AS RECORDS OF THE EARLY BIOSPHERE Abstract Only
DAVID J. DESMARAIS *In its* Exobiology and Future Mars Missions p 15-16 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

The abundance ratios of the stable isotopes of light elements such as carbon and sulfur can differ between various naturally-occurring chemical compounds. If coexisting compounds have achieved mutual chemical and isotopic equilibrium, then the relative isotopic composition can record the conditions at which equilibrium was last maintained. If coexisting chemical compounds indeed formed simultaneously but had not achieved mutual equilibrium, then their relative isotopic compositions often reflect the conditions and mechanisms associated with the kinetically controlled reactions responsible for their production. In the context of Mars, the stable isotopic compositions of various minerals might record not only the earlier environmental conditions of the planet, but also whether or not the chemistry of life ever occurred there. Two major geochemical reservoirs occur in Earth's crust, both for carbon and sulfur. In rocks formed in low temperature sedimentary environments, the oxidized forms of these elements tend to be enriched in the isotope having the larger mass, relative to the reduced forms. In sediments where the organics and sulfides were formed by biological processes, these isotopic contrasts were caused by the processes of biological CO2 fixation and dissimilatory sulfate reduction. Such isotopic contrasts between oxidized and reduced forms of carbon and sulfur are permitted by thermodynamics at ambient temperatures. However, nonbiological chemical reactions associated with the production of organic matter and the reduction of organics and sulfides are extremely slow at ambient temperatures. Thus the synthesis of organics and sulfides under ambient conditions illustrates life's profound role as a chemical catalyst that has altered the chemistry of Earth's crust. Because the stable isotopes of carbon and sulfur can reflect their chemistry, they are useful probes of the Martian surface. Author

N89-26347*# Florida State Univ., Tallahassee. Polar Desert Research Center and the Dept. of Biological Science.
MICROBIAL TRACE FOSSILS IN ANTARCTICA AND THE SEARCH FOR EVIDENCE OF EARLY LIFE ON MARS Abstract Only
E. IMRE FRIEDMANN and ROSELI O. FRIEDMANN (Florida Agricultural and Mechanical Univ., Tallahassee.) *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 22 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

It is possible to hypothesize that, if microbial life evolved on early Mars, fossil remnants of these organisms may be preserved on the surface. However, the cooling and drying of Mars probably resembled a cold desert and such an environment is not suitable for the process of fossilization. The frigid Ross Desert of Antarctica is probably the closest terrestrial analog to conditions that may have prevailed on the surface of the cooling and drying Mars. In this desert, cryptoendolithic microbial communities live in the airspaces of porous rocks, the last habitable niche in a hostile outside environment. The organisms produce characteristic chemical and physical changes in the rock substrate. Environmental changes (deterioration of conditions) may result in the death of the community. Although no cellular structures are fossilized, the conspicuous changes in the rock substrate are preserved as trace fossils. Likewise, microbial trace fossils (without cellular structures) may also be preserved on Mars: Discontinuities in structure or chemistry of the rock that are independent of physical or chemical gradients may be of biological origin. Ross Desert trace fossils can be used as a model for planning search strategies and for instrument design to find evidence of past Martian life. Author

N89-26348*# Missouri Univ., Columbia.
THE SEARCH FOR AND IDENTIFICATION OF AMINO ACIDS, NUCLEOBASES AND NUCLEOSIDES IN SAMPLES RETURNED FROM MARS Abstract Only
CHARLES W. GEHRKE, CYRIL PONNAMPERUMA, KENNETH C. KUO, DAVID L. STALLING, and ROBERT W. ZUMWALT (Cancer Research Center, Columbia, MO.) *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 23-24 Mar. 1989 Previously announced as N89-18318
Avail: NTIS HC A04/MF A01 CSCL 06/3

An investigation of the returned Mars samples for biologically important organic compounds, with emphasis on amino acid, the puring and pyrimidine bases, and nucleosides is proposed. These studies would be conducted on subsurface samples obtained by drilling past the surface oxidizing layer with emphasis on samples containing the larges quantities of organic carbon as determined by the rover gas chromatographic mass spectrometer (GCMS). Extraction of these molecules from the returned samples will be performed using the hydrothermal extraction technique described by Cheng and Ponnamperuma. More rigorous extraction methods will be developed and evaluated. For analysis of the extract for free amino acids or amino acids present in a bound or peptidic form, aliquots will be analyzed by capillary GCMS both before and after hydrolysis with 6N hydrochloric acid. Establishment of the presence of amino acids would then lead to the next logical step which would be the use of chiral stationary gas chromatography phases to determine the enatiomeic composition of the amino acids present, and thus potentially establish their biotic or abiotic origin. Confirmational analyses for amino acids

would include ion-exchange and reversed-phase liquid chromatographic analysis. For analyses of the returned Mars samples for nucleobases and nucleosides, affinity and reversed-phase liquid chromatography would be utilized. This technology coupled with scanning UV detection for identification, presents a powerful tool for nucleobase and nucleoside analysis. Mass spectrometric analysis of these compounds would confirm their presence in samples returned form Mars. Author

N89-26349*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SOIL DEVELOPMENTS IN POLAR DESERTS: IMPLICATIONS FOR EXOBIOLOGY AND FUTURE MARS MISSIONS Abstract Only
EVERETT K. GIBSON, JR. *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 25 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

Chemical alterations, weathering, and diagenesis of soil profiles from the dry valleys of Antarctica were studied as analogs of regolith development for the Martian regolith. Chemical weathering processes play an important part in soil development within the dry valleys of Antarctica. A suite of core samples were studied which were taken within the valley floors in addition to samples taken in the vicinity of evaporite and brine ponds. Analysis of water soluable cations and anions from core samples were performed along with petrographic analysis of selected samples. It was shown that ionic transport processes operate primarily above the permafrost zone. Abundances of the water soluable ions reflect the nature of secondary minerals produced by evaporation and weathering. Chloride, calcium, and sodium abundances for soils from the cores within the North and South Forks of Wright Valley, reflect the secondary mineralogy of the soil columns. Calculations for Na, Ca, and Cl abundances reflect the appearance of halite and antarcticite. In areas where excess Ca is present, X-ray diffraction studies show the presence of gypsum. It is well known that the Martian surface conditions may be favorable for chemical weathering. Primary silicates would be expected to be reactive with any ground water. It seems likely that Martian subsurface water is available to assist in the weathering of the primary minerals. Such weathering could result in the formation of clays, sulfates, carbonates, hydrates, halides, and zeolites. The dry valley cores have shown that they maybe excellent analogs to weathering processes on the near-surface of Mars. Since movement of water within the near-surface region clearly results in chemical weathering, leaching, and salt formation in the dry valleys, similar processes are probably operating within the Martian regolith.
Author

N89-26351*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MINERALOGICAL SINKS FOR BIOGENIC ELEMENTS ON MARS Abstract Only
J. L. GOODING *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 27-28 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

The efficacy of biochemical reactions on Mars should depend not only on concentrations of the biogenic elements H, C, N, O, and S but also on the forms (compounds and water-souble ions) that are available to those elements. It is possible that mineralogical reactions could act to lock biogenic elements into relatively inaccessible inorganic forms or, alternatively, to shelter sensitive organic compounds from chemically hostile environments. Recognition of these competing pathways is essential in planning sampling mission and in situ experiments directed toward assessing the biological potential of Mars. Author

N89-26353*# California Univ., Berkeley.
MARS, CLAYS AND THE ORIGINS OF LIFE Abstract Only
HYMAN HARTMAN *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 30-31 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

To detect life in the Martian soil, tests were designed to look for respiration and photosynthesis. Both tests (labeled release, LR, and pyrolytic release, PR) for life in the Martian soils were positive. However, when the measurement for organic molecules in the soil of Mars was made, none were found. The interpretation given is that the inorganic constituents of the soil of Mars were responsible for these observations. The inorganic analysis of the soil was best fitted by a mixture of minerals: 60 to 80 percent clay, iron oxide, quartz, and soluble salts such as halite (NaCl). The minerals most successful in simulating the PR and LR experiments are iron-rich clays. There is a theory that considers clays as the first organisms capable of replication, mutation, and catalysis, and hence of evolving. Clays are formed when liquid water causes the weathering of rocks. The distribution of ions such as aluminum, magnesium, and iron play the role of bases in the DNA. The information was stored in the distribution of ions in the octahedral and tetrahedral molecules, but that they could, like RNA and DNA, replicate. When the clays replicated, each sheet of clay would be a template for a new sheet. The ion substitutions in one clay sheet would give rise to a complementary or similar pattern on the clay synthesized on its surface. It was theorized that it was on the surface of replicating iron-rich clays that carbon dioxide would be fixed in the light into organic acids such as formic or oxalic acid. If Mars had liquid water during a warm period in its past, clay formation would have been abundant. These clays would have replicated and evolved until the liquid water was removed due to cooling of Mars. It is entirely possible that the Viking mission detected life on Mars, but it was clay life that awaits the return of water to continue its evolution into life based on organic molecules. Author

N89-26354*# Colgate Univ., Hamilton, NY. Dept. of Biology.
SNOW AS A HABITAT FOR MICROORGANISMS Abstract Only
RONALD W. HOHAM *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 32-33 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

There are three major habitats involving ice and snow, and the microorganisms studied from these habitats are most eukaryotic. Sea ice is inhabited by algae called diatoms, glacial ice has sparse populations of green algai cal desmids, and the temporary and permanent snows in mountainous regions and high latitudes are inhabited mostly by green algal flagellates. The life cycle of green algal flagellates is summarized by discussing the effects of light, temperature, nutrients, and snow melts. Specific examples of optimal conditions and environmental effects for various snow algae are given. It is not likely that the eukaryotic snow algae presented are candidated for life on the planet Mars. Evolutionally, eukaryotic cells as know on Earth may not have had the opportunity to develop on Mars (if life evolved at all on Mars) since eukaryotes did not appear on Earth until almost two billion years after the first prokaryotic organisms. However, the snow/ice ecosystems on Earth present themselves as extreme habitats were there is evidence of prokaryotic life (eubacteria and cyanbacteria) of which literally nothing is known. Any future surveillances of extant and/or extinct life on Mars should include probes (if not landing sites) to investigate sites of concentrations of ice water. The possibility of signs of life in Martian polar regions should not be overlooked. B.G.

N89-26355*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CHEMICAL EVOLUTION AND THE PRESERVATION OF ORGANIC COMPOUNDS ON MARS Abstract Only
ANASTASSIA KANAVARIOTI (California Univ., Santa Cruz.) and ROCCO L. MANCINELLI *In its* Exobiology and Future Mars Missions p 34-35 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

Several lines of evidence suggest that the environment on early Mars and early Earth were very similar. Since life is abundant on Earth, it seems likely that conditions on early Earth were conducive to chemical evolution and the origin of life. The similarity between early Mars and early Earth encourages the hypothesis that chemical evolution might have also occurred on Mars, but that decreasing temperatures and the loss of its atmosphere

brought the evolution to a halt. The possibility of finding on Mars remnants of organic material dating back to this early clement period is addressed. Author

N89-26356*# Santa Clara Univ., CA. Dept. of Biology.
THE VIKING BIOLOGY RESULTS Abstract Only
HAROLD P. KLEIN *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 36-37 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

A brief review of the purposes and the results from the Viking Biology experiments is presented, in the expectation that the lessons learned from this mission will be useful in planning future approaches to the biological exploration of Mars. Since so little was then known about potential micro-environments on Mars, three different experiments were included in the Viking mission, each one based on different assumptions about what Martian organisms might be like. In addition to the Viking Biology Instrument (VBI), important corollary information was obtained from the Viking lander imaging system and from the molecular analysis experiments that were conducted using the gas chromatograph-mass spectrometer (GCMS) instrument. No biological objects were noted by the lander imaging instrument. The GCMS did not detect any organic compounds. A description of the tests conducted by the Gas Exchange Experiment, the Labeled Release experiment, and the Pyrolytic Release experiment is given. Results are discussed. Taken as a whole, the Viking data yielded no unequivocal evidence for a Martian biota at either landing site. The results also revealed the presence of one or more reactive oxidants in the surface material and these need to be further characterized, as does the range of micro-environments, before embarking upon future searches for extant life on Mars. A.D.

N89-26357*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ECOLOGICAL CONSIDERATIONS FOR POSSIBLE MARTIAN BIOTA Abstract Only
JUNE M. KLINGLER, ROCCO L. MANCINELLI, and MELISA R. WHITE *In its* Exobiology and Future Mars Missions p 38 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

Current climatic and geological evidence suggests that, like early Earth, conditions on ancient Mars may also have been favorable for the origin and evolution of life. The primordial atmospheres of the two planets were quite similar, composed primarily of CO2, N2, and water vapor at a total atmospheric pressure of approximately 1 bar. Each of these gases are important for the evolution of biological systems. With the exception of nitrogen, there seems to have been a sufficient supply of the biogenic elements C, H, O, P, and S (CHOPS) on early Mars for life to have evolved. It was postulated that primordial Mars contained only 18 mb of nitrogen in the form of N2 given that only fixed nitrogen is utilized by living systems. Laboratory tests performed at a total pressure of 1 bar and various partial pressures of dinitrogen (pN2 1-780 mb) show that nitrogen fixing organisms grow at pN2's of 18 mb or less, although the biomass and growth rates are decreased. The calcualted in vivo Km's ranged from 46 mb to 130 mb. If organisms adapted on Earth to a pH2 of 780 mb are capable of growing at these low partial pressures, it is conceivable that nitrogen was not the limiting factor in the evolution of life on early Mars. A.D.

N89-26358*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A SEARCH FOR BIOGENIC TRACE GASES IN THE ATMOSPHERE OF MARS Abstract Only
JOEL S. LEVINE and CHRISTOPHER P. MCKAY (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.) *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 39 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

The detection of certain trace gases in the atmosphere of Mars may serve as a possible indicator of microbial life on the surface of Mars. Candidate biogenic gases include methane CH4, ammonia NH3, nitrous oxide N2O, and several reduced sulfur species. Chemical thermodynamic equilibrium and photochemical calculations preclude the presence of these gases in any measurable concentrations in the atmosphere of Mars in the absence of biogenic production. A search for these gases utilizing either high resolution (spectral and spatial) spectroscopy from a Mars orbiter, such as the Observer, and or in situ measurements from a Mars lander or rover, is proposed. Author

N89-26360*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE NITROGEN CYCLE ON MARS Abstract Only
ROCCO L. MANCINELLI *In its* Exobiology and Future Mars Missions p 42 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

Nirtogen is an essential element for the evolution of life, because it is found in a variety of biologically important molecules. Therefore, N is an important element to study from a exobiological perspective. In particular, fixed nitrogen is the biologically useful form of nitrogen. Fixed nitrogen is generally defines as NH3, NH4(+), NO(x), or N that is chemically bound to either inorganic or organic molecules, and releasable by hydrolysis to NH3 or NH4(+). On Earth, the vast majority of nitrogen exists as N2 in the atmosphere, and not in the fixes form. On early Mars the same situations probably existed. The partial pressure of N2 on early Mars was thought to be 18 mb, significantly less than that of Earth. Dinitrogen can be fixed abiotically by several mechanisms. These mechanisms include thernal shock from meteoritic infall and lightning, as well as the interaction of light and sand containing TiO2 which produces NH3 that would be rapidly destroyed by photolysis and reaction with OH radicals. These mechanisms could have been operative on primitive Mars.The chemical processes effecting these compounds and possible ways of fixing or burying N in the Martian environment are described. Data gathered in this laboratory suggest that the low abundance of nitrogen along (compared to primitive Earth) may not significantly deter the origin and early evolution of a nitrogen utilizing organisms. However, the conditions on current Mars with respect to nitrogen are quite different, and organisms may not be able to utilize all of the available nitrogen. Author

N89-26364*# Indiana Univ., Bloomington. Inst. for Molecular and Cellular Biology.
PHYLOGENETIC PERSPECTIVE AND THE SEARCH FOR LIFE ON EARTH AND ELSEWHERE Abstract Only
NORMAN R. PACE *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 50-51 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

Any search for microbial life on Mars cannot rely upon cultivation of indigenous organisms. Only a minority of even terrestrial organisms that are observed in mixed, naturally-occurring microbial populations can be cultivated in the laboratory. Consequently, methods are being developed for analyzing the phylogenetic affiliations of the constituents of natural microbial populations without the need for their cultivation. This is more than an exercise in taxonomy, for the extent of phylogenetic relatedness between unknown and known organisms is some measure of the extent of their biochemical commonalities. In one approach, total DNA is isolated from natural microbial populations and 16S rRNA genes are shotgun cloned for rapid sequence determinations and phylogenetic analyses. A second approach employs oligodeoxynucleotide hybridization probes that bind to phylogenetic group-specific sequences in 16S rRNA. Since each actively growing cell contains about 104 ribosomes, the binding of the diagnostic probes to single cells can be visualized by radioactivity or fluorescence. The application of these methods and the use of in situ cultivation techniques is illustrated using submarine hydrothermal vent communities. Recommendations are made regarding planning toward future Mars missions. Author

N89-26365*# Puget Sound Univ., Tacoma, WA. Dept. of Biology.
GROWTH OF A MAT-FORMING PHOTOGRAPH IN THE PRESENCE OF UV RADIATION Abstract Only
BEVERLY K. PIERSON and A. L. RUFF *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 52-53 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

Knowledge of the survival and growth of microorganisms in the presence of ultraviolet radiation is important for understanding the potential for life to exist in environments exposed to high fluxes of UV radiation. The growth of a mat-forming phototrophic prokaryote, Chloroflexus aurantiacus, was examined in the presence of continuous high UV irradiation under otherwise optimal growth conditions. Evidence was sought for an intrinsic ability to grow in the presence of UV radiation in a carefully chosen organism known to be unusually resistant to UV radiation, of ancient lineage among the phototrophs, to resemble ancient microfossils from the Precambrian, and to be a mat-former. It was assumed that even a high intrinsic UV resistance would be inadequate for survival and growth in the presence of very high UV fluxes, and iron (Fe3+) was selected as a common, abundant UV-absorbing substance that might protest microorganisms growing in or under iron-bearing sediments. The effectiveness of Fe(3+) was tested as a UV protective agent at low concentrations in thin layers. It was concluded that intrinsic UV resistance in some organisms may account for growth, not just survival, of these organisms when exposed to high UV fluxes under otherwise optimal growth conditions in an anoxic environment. It was also concluded that Fe(3+) bearing sediments of 1 mm or less in thickness may provide an adequate shield against high UV fluxes permitting the growth of microorganisms just below their surface. As long as growth conditions were met, then the evolution and development of microorganisms would not be hampered by high UV fluxes impinging upon the surface of iron-bearing sediments. A.D.

N89-26369*# Cincinnati Univ., OH. Dept. of Biological Sciences.
THE METABOLISM OF THE ANTARTIC CRYTOENDOLITHIC MICROBIOTA Abstract Only
J. ROBIE VESTAL *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 59 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

The carbon metabolism of the cryptoendolithic microbiota in sandstones from the Ross Desert region of Antarctica was studied in situ and in vitro. Organic and inorganic compounds were metabolized by the microbiota, with bicarbonate being metabolized maximally in the light. There was a linear response of photosynthesis to light up to 200 to 300 micromole photons/sq m/s. The community photosynthetic response to temperature was a minimum at -5 C, two optima at +5 and +15 C and a maximum at +35 C. Photosynthetic metabolism occurred maximally in the presence of liquid water, but could occur in an environment of water vapor. Biomass of the cryptoendolithic microbiota was measured as the amount of lipid phosphate present. The in situ biomass ranged from 1.92 to 3.26 g carbon/sq m of rock and 2 orders of magnitude less than epilithic lichen microbiota from Antarctica in a location 7 degrees more north in latitude. With these data, it was possible to calculate primary production and carbon turnover in this simple microbiota. Production values ranged from 0.108 to 4.41 mg carbon/sq m/yr, while carbon turnover values ranged from 576 to 23,520 years. These values are the lowest and longest yet recorded for any ecosystem on Earth. If life did evolve on Mars to the level of prokaryotes or primitive eukaryotes, the possibility that the organisms retreated, to the protection of the inside of the rock so that metabolism could continue during planetary cooling, cannot be overlooked. Author

N89-26372*# Tennessee Univ., Knoxville. Inst. for Applied Microbiology.
DETECTION OF MICROBES IN THE SUBSURFACE Abstract Only
DAVID C. WHITE and ANDERS TUNLID *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 63-64 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

The search for evidence of microbial life in the deep subsurface of Earth has implications for the Mars Rover Sampling Return Missions program. If suitably protected environments can be found on Mars then the instrumentation to detect biomarkers could be used to examine the molecular details. Finding a lipid in Martian soil would represent possibly the simplest test for extant or extinct life. A device that could do a rapid extraction possibly using the supercritical fluid technology under development now with a detection of the carbon content would clearly indicate a sample to be returned. Author

N89-26373*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AUTONOMOUS EXPLORATION SYSTEM: TECHNIQUES FOR INTERPRETATION OF MULTISPECTRAL DATA Abstract Only
GIGI YATES and SUSAN EBERLEIN *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 65-66 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

An on-board autonomous exploration system that fuses data from multiple sensors, and makes decisions based on scientific goals is being developed using a series of artificial neural networks. Emphasis is placed on classifying minerals into broad geological categories by analyzing multispectral data from an imaging spectrometer. Artificial neural network architectures are being investigated for pattern matching and feature detection, information extraction, and decision making. As a first step, a stereogrammetry net extracts distance data from two gray scale stereo images. For each distance plane, the output is the probable mineral composition of the region, and a list of spectral features such as peaks, valleys, or plateaus, showing the characteristics of energy absorption and reflection. The classifier net is constructed using a grandmother cell architecture: an input layer of spectral data, an intermediate processor, and an output value. The feature detector is a three-layer feed-forward network that was developed to map input spectra to four geological classes, and will later be expanded to encompass more classes. Results from the classifier and feature detector nets will help to determine the relative importance of the region being examined with regard to current scientific goals of the system. This information is fed into a decision making neural net along with data from other sensors to decide on a plan of activity. A plan may be to examine the region at higher resolution, move closer, employ other sensors, or record an image and transmit it back to Earth. Author

N89-26374# Washington Univ., Seattle. Dept. of Medicine.
INFLUENCE OF STRESS-INDUCED CATECHOLAMINES ON MACROPHAGE PHAGOCYTOSIS Annual Report, 1 Jan. - 31 Dec. 1988
ITAMAR B. ABRASS and CHRISTINE K. ABRASS 1 Apr. 1989 25 p
(Contract N00014-87-K-0369; NADC PROJ. RR-0-4-108)
(AD-A206608) Avail: NTIS HC A02/MF A01 CSCL 06/1

Beta-adrenergic receptor concentration and adenylate cyclase activity change with macrophage activation. Resident (R) and thioglycollate (TG)-stimulated macrophages (MO) have comparable concentrations of beta-adrenergic receptors (2136 +/-143 and 2110 +/-327 sites/cell respectively), while Bacillus Calmette Guerin (BCG)-activated macrophages have 62% fewer beta-adrenergic receptors (808 +/-190 sites/cell). The increase in adenylate cyclase activity in TG-macrophages as compared to resident-macrophages results in increased sensitivity to catecholamines. FcR-mediated phagocytosis is dependent on FcR concentration, internalization and intra-cellular digestion of receptor-bound material. Catecholamines increase the concentration of FcR which in turn increases the availability of immune complexes for phagocytosis by the cell. Catecholamines also decrease internalization and/or digestion of FcR-bound immune complexes. Thus, the net effect of catecholamines on total phagocytosis is the consequence of the balance of

independent effects of catecholamines on FcR concentration and the efficiency of internalization and degradation of bound material. GRA

N89-26375# Massachusetts Inst. of Tech., Cambridge. Lab. for Electromagnetic and Electronic Systems.
THEORETICAL MODELS FOR INTERACTION OF ELECTROMAGNETIC FIELDS WITH BIOLOGICAL TISSUES
Final Report, 1 Jul. 1986 - 1 Jul. 1988
JEREMY H. NUSSBAUM and ALAN J. GRODZINSKY Jan. 1989 28 p
(Contract F33615-83-D-0601)
(AD-A206923; USAFSAM-TR-88-18) Avail: NTIS HC A03/MF A01 CSCL 06/7

This work demonstrates that electric fields can modulate intra-membrane ionic concentrations, transmembrane ionic fluxes, mechanical conformation of membranes, and transmembrane potential. Even symmetrically applied fields of opposite polarities can result in asymmetric mechanical, concentration and flux responses, hence rectification of electrochemical and electrochemical phenomena can produce long-term effects even though the induced change is small. The general electro-mechano-chemical model presented predicts rectification phenomena and includes mechanical and electromechanical conformational change dynamics. GRA

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AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

A89-43710* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PHYSIOLOGICAL EFFECTS OF SPACE FLIGHT
CAROLYN L. HUNTOON (NASA, Johnson Space Center, Houston, TX) IN: Space - A new community of opportunity; Proceedings of the Thirty-fourth Annual AAS International Conference, Houston, TX, Nov. 3-5, 1987. San Diego, CA, Univelt, Inc., 1989, p. 219-224.
(AAS PAPER 87-644)

Data from Skylab and Space Shuttle missions are used as a framework for discussing the physiological effects of space flight. Consideration is given to motion sickness, and changes in body fluids, the cardiovascular system, and red blood cell counts. In addition, changes in muscle mass, bone mass, and the immune system, and neurosensory disturbances are examined. R.B.

A89-43711* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MEDICAL CARE DELIVERY IN SPACE
DON F. STEWART (NASA, Johnson Space Center, Houston, TX) IN: Space - A new community of opportunity; Proceedings of the Thirty-fourth Annual AAS International Conference, Houston, TX, Nov. 3-5, 1987. San Diego, CA, Univelt, Inc., 1989, p. 225-230.
(AAS PAPER 87-645)

Consideration is given to the delivery of medical care in space. The history of aviation medicine is reviewed. Medical support for the early space programs is discussed, including the Mercury, Gemini, Apollo, and Skylab programs. The process of training crew members for basic medical procedures for the Space Shuttle program is briefly described and medical problems during the Shuttle program are noted. Plans for inflight medical care on the Space Station are examined, including the equipment planned for the Health Maintenance Facility, the use of exercise to help prevent medical problems. R.B.

A89-44295
MINERALIZATION OF HUMAN BONE TISSUE UNDER HYPOKINESIA AND PHYSICAL EXERCISE WITH CALCIUM SUPPLEMENTS
YAN G. ZORBAS, GRIGORI E. VERENTSOV, and NIKOLAI I. ABRATOV (Academia de Stiinte Medicale, Institutul de Fiziologie Normala si Patologica, Bucharest, Rumania) Acta Astronautica (ISSN 0094-5765), vol. 19, April 1989, p. 347-351. refs

The possible use of Ca supplements and physical exercise to prevent demineralization of bone tissue under hypokinesia is examined. The mineral content of bones of 12 physically healthy men between the ages of 19 and 24 was measured after 90 days of hypokinesia. An experimental group consisting of half of the men took 650 mg of calcium lactacte supplement 6 times a day and participated in intensive physical exercise regularly, while the control group was place under pure hypokinesia. It is found that the bone density of the control group decreased by 7-9 percent, while that of the experimental group dropped by 5-7 percent. It is concluded that the level of mineralization of bone tissues decreases under hypokinesia, even with the inclusion of physical exercise and Ca supplements. R.B.

A89-44376
INCREASED EXERCISE SA(O2) INDEPENDENT OF VENTILATORY ACCLIMATIZATION AT 4,300 M
PAUL R. BENDER, ROBERT E. MCCULLOUGH, ROSANN G. MCCULLOUGH, SHAO-YUNG HUANG, PETER D. WAGNER (Colorado, University, Denver; California, University, La Jolla; U.S. Army, Research Institute for Environmental Medicine, Natick, MA) et al. Journal of Applied Physiology (ISSN 0161-7567), vol. 66, June 1989, p. 2733-2738. refs
(Contract NIH-HL-14985; NIH-HL-17731)

The effect of submaximal exercise on the time curse and patterns of arterial O2 saturation, Sa(O2), during several weeks of acclimatization to 4300-m altitude was investigated by comparing the Sa(O2) results obtained on days 2, 8, and 22 at 4300 m from subjects who performed prolonged steady-state cycle exercise at 79 percent maximal O2 uptake with results obtained on resting subjects. It was found that all of the Sa(O2) increase in resting subjects occurred from day 1 to day 8, whereas, in the exercise group, the Sa(O2) values increased from day 2 to day 8 (5.9 percent), and then increased further from day 8 to day 22 (3.7 percent), despite an unchanged ventilation and O2 consumption. The increased exercise Sa(O2) was accompanied by decreased CO2 production. I.S.

A89-44377* Marquette Univ., Milwaukee, WI.
CONTRACTILE FUNCTION OF SINGLE MUSCLE FIBERS AFTER HINDLIMB SUSPENSION
P. R. GARDETTO, J. M. SCHLUTER, and R. H. FITTS (Marquette University, Milwaukee, WI) Journal of Applied Physiology (ISSN 0161-7567), vol. 66, June 1989, p. 2739-2749. refs
(Contract NAG2-212)

The effects of two weeks of hind-limb suspension (HS) on the functional properties of slow-twitch and fast-twitch single fibers isolated from the predominantly slow-twitch soleus and fast-twitch gastrocnemius of the suspended leg of rats were investigated. Single fibers were suspended between a motor arm and force transducer, and, after their functional properties were studied, the fiber type was established by the myosin heavy chain analysis. It was found that, after HS, the greatest decrease in diameter and a reduction in peak tension occurred in slow-twitch fibers from soleus, followed by slow-twitch fibers from gastrocnemius. Fast-twitch fibers from the red gastrocnemius showed a significant reduction in diameter but no change in peak tension. No effect of HS was observed on the diameter of the fast-twitch fibers from the white gastsrocnemius (which is known to contain 87 percent fast glycolytic fibers). I.S.

A89-44378* Arizona Univ., Tucson.
GLYCOGEN SUPERCOMPENSATION IN RAT SOLEUS MUSCLE DURING RECOVERY FROM NONWEIGHT BEARING
ERIK J. HENRIKSEN, CHRISTOPHER R. KIRBY, and MARC E.

TISCHLER (Arizona, University, Tucson) Journal of Applied Physiology (ISSN 0161-7567), vol. 66, June 1989, p. 2782-2787. refs
(Contract NAG2-384; NIH-RR-05675)

Events leading to the normalization of the glycogen metabolism in the soleus muscle of rat, altered by 72-h three days of hind-limb suspension, were investigated during the 72-h recovery period when the animals were allowed to bear weight on all four limbs. Relative importance of the factors affecting glycogen metabolism in skeletal muscle during the recovery period was also examined. Glycogen concentration was found to decrease within 15 min and up to 2 h of recovery, while muscle glucose 6-phosphate, and the fractional activities of glycogen phosphorylase and glycogen synthase increased. From 2 to 4 h, when the glycogen synthase activity remained elevated and the phosphorylase activity declined, glycogen concentration increased, until it reached maximum values at about 24 h, after which it started to decrease, reaching control values by 72 h. At 12 and 24 h, the inverse relationship between glycogen concentration and the synthase activity ratio was lost, indicating that the reloading transiently uncoupled glycogen control of this enzyme. I.S.

A89-44874
BRIGHT LIGHT INDUCTION OF STRONG (TYPE O) RESETTING OF THE HUMAN CIRCADIAN PACEMAKER

CHARLES A. CZEISLER, JAMES S. ALLAN, JEANNE F. DUFFY, MEGAN E. JEWETT (Harvard University; Women's Hospital, Boston, MA), RICHARD E. KRONAUER (Harvard University, Cambridge, MA) et al. Science (ISSN 0036-8075), vol. 244, June 16, 1989, p. 1328-1333. Research supported by the Center for Design of Industrial Schedules. refs
(Contract NIH-1-RO1-AG-06072; NIH-5-M01-RR-00888; NIH-S07-RR-05950)

The response of the human circadian pacemaker to light was measured in 45 resetting trials. Each trial consisted of an initial endogenous circadian phase assessment, a three-cycle stimulus which included 5 hours of bright light per cycle, and a final phase assessment. The stimulus induced strong (type O) resetting, with responses highly dependent on the initial circadian phase of light exposure. The magnitude and direction of the phase shifts were modulated by the timing of exposure to ordinary room light, previously thought to be undetectable by the human pacemaker. The data indicate that the sensitivity of the human circadian pacemaker to light is far greater than previously recognized and have important implications for the therapeutic use of light in the management of disorders of circadian regulation. Author

A89-45338
BOND SCINTIGRAPHY IN THE EVALUATION OF EJECTION INJURIES

R. F. BURY (Princess Mary's RAF Hospital, Halton, England) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. A16, A17.

A89-45339
MECHANISM OF INJURY IN AIRCRAFT ACCIDENTS - A THEORETICAL APPROACH

I. R. HILL (RAF, Institute of Pathology and Tropical Medicine, Halton, England) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. A18-A25. refs

The mechanisms of injury produced in aircraft accidents are discussed. Consideration is given to the causes of injury, which include crushing within a collapsing airframe, entrapment within the wreckage, the absence or failure of restraint, impacts by loose objects, escape mishaps, and explosive decompression. Particular attention is given to the possibility of correlating the topography of a wound with its cause. It is shown that the injuruy production in aircraft accidents is a complex issue that cannot be easily resolved, because not all of the basic science is known, and even the principles are controversial. It is emphasized that the limiting factor in survivability may be the pathophysiological response of the biological system, and that this fact, combined with varying physiochemical properties of given tissues, may be the key factor to tolerance to injury. I.S.

A89-45340
AN EVALUATION OF PROPOSED CAUSAL MECHANISMS FOR ÅEJECTION ASSOCIATEDÅ NECK INJURIES

FREDERICK C. GUILL and G. RONALD HERD (U.S. Navy, Crew Systems Div., Washington, DC) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. A26-A47. refs

Possible causal factors and mechanisms responsible for neck injuries associated with various phases of aircraft ejection (i.e., preejection, ejection through catapult boost, postboost, and postparachute opening) were identified using data from the data bank at the Naval Weapons Engineering Support Activity. The body motions and forces associated with through-the-canopy ejection are analyzed and the spectral range neck fractures and sprains/strains, and the ranges of their severity are examined. The relations between the severity of neck injury and the ejection speed, aircraft series, aircraft maneuver load and speed, the type of ejection seat, the factor of lost helmet, the body position, and the parachute opening shock are investigated. Evidence is presented that many of the reported neck injuries were the consequence of system malfunction. I.S.

A89-45341
PLACE OF BIOCHEMICAL TESTS IN AIRCREW MEDICAL EXAMINATIONS

S. A. CULLEN (RAF, Institute of Pathology and Tropical Medicine, Halton, England) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. A48, A49. refs

This paper addresses the significance of biochemical tests as probes for specific conditions that determine the fitness to fly in aircrew personnel, and stresses the necessity to test only for those conditions rather than conducting a battery of general tests. It is pointed out that most patients with positive tests may not have the target disorder, and each will require a time-consuming definitive evaluation and diagnosis. The list of conditions which should be excluded before an airman is permitted to fly (including a severe personality disorder, psychosis, alcoholism, drug dependency, epilepsy, myocardial infarction, angina pectoris, and diabetes mellitus) determines the range of biochemical tests that should be included in the medical examination. It is noted that, with respect to abuse of alcohol, questioning is superior for screening than biochemical tests. I.S.

A89-45342
INVESTIGATION OF INCIDENTS OF TERRORISM INVOLVING COMMERCIAL AIRCRAFT

MICHAEL A. CLARK, GLENN N. WAGNER, DONALD G. WRIGHT, CHARLES J. RUEHLE, and ELISABETH W. MCDONNELL (U.S. Armed Forces Institute of Pathology, Washington, DC) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. A55-A59.

Aircraft bombings and hijackings can create extremely sensitive political situations and public demands for quick resolution. This paper describes the type of evidence recovered upon the autopsy of victims in such circumstances, which enables the reconstruction of events leading to the victim's death, and, in case of a bomb explosion, the determination of the position of the bomb and the identification of the explosive device. It is shown that the mechanism that produced fatal injuries in case of in-flight bombings (such as blast, shrapnel, decompression, impact with the aircraft, or ground impact) can be identified. I.S.

A89-45343
THE ROLE OF FORENSIC ANTHROPOLOGY IN MASS DISASTER RESOLUTION

MADELEINE J. HINKES (U.S. Army, Central Identification Laboratory, Fort Shafter, HI) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. A60-A63. refs

On Dec. 12, 1985, a military charter DC-8 crashed shortly after takeoff at Gander, Nfld., Canada. All 256 aboard were killed, making

this the deadliest U.S. military aircraft accident in history. The investigation team (consisting of forensic pathologists, odontologists, radiologists, anthropologists, graves registration personnel, and systems engineers) succeeded in identifying the remains of all 248 manifested passengers and 8 crewmembers. The unique contribution of anthropology necessitates that a forensic anthropologist be included in all phases of casualty resolution from recovery and initial processing to final evaluation, rather than being summoned as a last resort. This approach would yield immediate information on 'unknowns' and would eliminate subsequent duplication of effort. Author

A89-45344
MASS FATALITY AIRCRAFT DISASTER PROCESSING
MICHAEL A. CLARK, STANLEY R. CLARK, and DAVID G. PERKINS (U.S. Armed Forces Institute of Pathology, Washington, DC) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. A64-A73.

The processing of the December 12, 1985 crash at Gander, Canada of a contract transport carrying 248 U.S. Army personnel is discussed in detail, and the logistics of the operations are outlined. The human remains were transported to the U.S. Air Force mortuary facility at Dover, DE, where each set of remains was assigned a control number, and the remains were identified on the basis of photographs, fingerprints, and the results of dental examination, full-body X-rays, and autopsy. The experience in processing the fatalities from the Gander crash was used in the design of a Disaster Identification Center (DIC). The organization of DIC is described together with the policies and procedures for its operation, and the responsibilities of each member of the DIC personnel. I.S.

A89-45346
REVIEW OF MALARIA PROPHYLACTIC DRUGS FOR PERFORMANCE EFFECTS IN NAVAL AVIATORS
GARY G. REAMS (U.S. Navy, Naval Aerospace Medical Institute, Pensacola, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. A77-A79. refs

A89-45347
SCREENING FOR MITRAL VALVE PROLAPSE - AN ANALYSIS OF BENEFITS AND COSTS IN THE U.S. AIR FORCE
W. DOUGLAS EVERETT (Texas, University, Dallas; John Peter Smith Hospital, Fort Worth) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. A80-A88. refs

A89-45349
DESCRIPTIVE ANALYSIS OF MEDICAL ATTRITION IN U.S. ARMY AVIATION
RONALD J. EDWARDS (Eisenhower Medical Center, Augusta, GA) and DUDLEY R. PRICE (U.S. Army, Aeromedical Research Laboratory, Fort Rucker, AL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. A92-A97.

A descriptive analysis of diseases in the U.S. Army aviation population, which develop some time after the entry into the army, is presented with the purpose of establishing a basis for future improvements in screening and prevention. Data are presented on the medical losses of all aircraft personnel, according to sex, race, age, rank, and the exam class (with the percent observed vs. expected losses given); the specific disease sources eliminating aviation personnel; specific diseases suspending rated pilots; expected vs. observed rates of suspensions of rated pilots due to specific diseases, and the sources of medical elimination from flight training. It was found that, of the causes of medical attrition potentially creating sudden incapacitation, the coronary artery disease, alcohol abuse, diabetes mellitus, syncope, migraine, vertigo, and asthma appear in that order of frequency. I.S.

A89-45501
VISUAL DISPLAY LOWERS DETECTION THRESHOLD OF ANGULAR, BUT NOT LINEAR, WHOLE-BODY MOTION STIMULI
A. J. BENSON and SALLY F. BROWN (RAF, Institute of Aviation Medicine, Farnborough, England) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. 629-633. refs

The effect of a visual display, fixed relative to the subject, on the thresholds of the subject's detection of discrete Y-axis linear movements and Z-axis angular movements was investigated using an apparatus described by Benson et al. (1986, 1989) for presenting discrete stimuli to the 12 subjects used in the study. Results demonstrated that, when either a simple LED display or an instrument dial were illuminated, the thresholds for the detection of the linear motion stimuli were not significantly different from those obtained in darkness, in contrast with the responses obtained with rotational stimuli, which exhibited a reduction in threshold and the presence of oculogyral illusions at stimulus intensities at or below the level required to detect whole-body angular movement in the dark. These results indicate that otolithic afferents, unlike those from the semicircular canals, do not interact with neural centers mediating visual localization. I.S.

A89-45502
LOW TEMPERATURE WORSENS MAMMALIAN OXYGEN TOXICITY
DANA JAMIESON and JOHN CARMODY (New South Wales, University, Kensington, Australia) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. 639-643. refs

The effects of ambient temperature on lung damage and the central nervous system (CNS) toxicity in mice were investigated by exposing mice to 5 ATA of oxygen at four ambient temperatures (35, 25, 15, and 5 C). Controls were exposed to 5 ATA N2. The CNS toxicity was measured as the latent period before convulsions, while lung damage was assessed by wet and dry weight measurements. Results showed that hyperbaric oxygen induced hypothermia (as determined by rectal temperature measurements); this effect was profound in mice exposed to 5 ATA O2 at 15 and 5 C. The combination of low temperature and hyperbaric oxygen produced much more severe lung damage than either treatment alone, indicating that hyperoxic-induced hypothermia cannot be considered as a protective mechanism against oxygen toxicity. I.S.

A89-45503* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
HUMAN MONONUCLEAR CELL FUNCTION AFTER 4 C STORAGE DURING 1-G AND MICROGRAVITY CONDITIONS OF SPACEFLIGHT
RICHARD MEEHAN, GERALD TAYLOR, FABIAN LIONETTI, LAURIE NEALE, and TIM CURREN (NASA, Johnson Space Center, Houston; Texas, University, Galveston; Center for Blood Research, Boston, MA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. 644-648. refs

To investigate the possibility of restoring immune competence of crewmembers during a prolonged spaceflight by infusions of autologous blood components, the effect of storage at 4 C aboard Space Shuttle Columbia (Mission 61-c) on the activity of human peripheral blood mononuclear cells (PBMNCs), stored as leukocyte concentrates in autologous plasa, was investigated. The results of preflight storage at 4 C demonstrated a progressive daily loss in mitogen-stimulated protein synthesis, and thymidine uptake, as well as a progressive reduction in the percentage of PBMNCs expressing cell-surface phenotype markers. The ability of PBMNCs stored at 4 C for 8 d in Columbia's middeck, to become activated and proliferate in vitro was similar to that of cells that remained for 7 d on ground. I.S.

A89-45504* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
A STUDY OF THE EFFECTS OF PROLONGED SIMULATED MICROGRAVITY ON THE MUSCULATURE OF THE LOWER EXTREMITIES IN MAN - AN INTRODUCTION
PAUL BUCHANAN and VICTOR A. CONVERTINO (NASA, Kennedy Space Center, Cocoa Beach, FL) Aviation, Space, and

Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. 649-652. refs

The experimental approach and the protocol are described for a study designed to investigate the effect of prolonged microgravity (simulated by a continuous exposure of subjects to 30-d-long 6-deg headdown tilt) on the musculature of the lower extremities in humans. The objectives of this study are as follows: (1) to determine changes in the functional characteristics of knee joint flexor and extensor muscle group; (2) to examine changes in the histochemical, biochemical, electron microscopic, and computed tomographic characteristics of skeletal muscle; (3) to determine if functional characteristics of skeletal muscle would be normalized four weeks after the bedrest; and (4) to compare these results to those of spaceflight. Percutaneous muscle biopsy, computed tomography, anthropometry, and in vivo muscle strength measurements are to be used to assess mechanical, structural, and metabolic characteristics of skeletal muscle. I.S.

A89-45505* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
CHANGES IN VOLUME, MUSCLE COMPARTMENT, AND COMPLIANCE OF THE LOWER EXTREMITIES IN MAN FOLLOWING 30 DAYS OF EXPOSURE TO SIMULATED MICROGRAVITY
VICTOR A. CONVERTINO, DONALD F. DOERR, PAUL BUCHANAN (NASA, Kennedy Space Center, Cocoa Beach, FL), KAREN L. MATHES (NASA, Kennedy Space Center; Bionetics Corp., Cocoa Beach, FL), and STEWARD L. STEIN (Sunnyvale Medical Clinic, Dept. of Radiology, CA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. 653-658. refs
(Contract NAS10-10285)

To investigate the relationship between leg compliance and a reduction in the size of the leg muscle compartment due to long-duration exposure to microgravity, eight men were exposed for 30 d of continuous 6-deg headdown tilt, and changes in vascular compliance (vol pct/mm Hg x 100) of the calf and serial circumferences of the thigh and the calf were measured before, during, and after the tilt. It was found that the tilt exposure led to calculated leg volume decreases of 9.9 percent in the calf and of 4.5 in the thigh. Leg compliance was found to increase from 3.9 to about 4.9. Calf compliance measured before and after bedrest was found to be inversely related to calf-muscle compartment cross-sectional area (CSA). I.S.

A89-45506* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
ALTERATIONS OF THE IN VIVO TORQUE-VELOCITY RELATIONSHIP OF HUMAN SKELETAL MUSCLE FOLLOWING 30 DAYS EXPOSURE TO SIMULATED MICROGRAVITY
GARY A. DUDLEY (NASA, Kennedy Space Center; Bionetics Corp., Biomedical and Environmental Laboratories, Cocoa Beach, FL), MARC DUVOISIN, VICTOR A. CONVERTINO, and PAUL BUCHANAN (NASA, Kennedy Space Center, Cocoa Beach, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. 659-663. refs
(Contract NAS10-10285)

The effect of a continuous 30-d-long 6-deg headdown bedrest (BR) on the force output ability of skeletal muscles was investigated in human subjects by measuring peak angle specific torque of the knee extensor (KE) and knee flexor (KF) muscle groups of both limbs during unilateral efforts at four speeds (0.52. 1.74, 2.97, and 4.19 rad/sec) during eccentric action. It was found that, for the KE muscle group, the headdown BR resulted in decreases, by 19 percent on the average, of peak angle specific torque; on the other hand, the strength of the KF muscles was not altered significantly. A post-BR recovery for 30 days was found to restore muscle strength of the KE muscle group to about 92 percent of the pre-BR values. Changes of strength were not affected by the type of speed of muscle action. I.S.

A89-45507* Ohio Univ., Athens.
STRUCTURAL AND METABOLIC CHARACTERISTICS OF HUMAN SKELETAL MUSCLE FOLLOWING 30 DAYS OF SIMULATED MICROGRAVITY
ROBERT S. HIKIDA (Ohio University, Athens), PHILIP D. GOLLNICK (Washington State University, Pullman), GARY A. DUDLEY (NASA, Kennedy Space Center; Bionetics Corp., Biomedical and Environmental Laboratories, Cocoa Beach, FL), VICTOR A. CONVERTINO, and PAUL BUCHANAN (NASA, Kennedy Space Center, Cocoa Beach, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. 664-670. refs

The effects of simulated microgravity (30 days of continuous 6-deg headdown bedrest, BR) on the structural and metabolic characteristics of human skeletal muscle were determined. Percutaneous needle biopsy samples obtained from the vastus lateralis and soleus muscles before and after the headdown BR were analyzed for histochemical, biochemical and ultrastructual changes. It was found that headdown BR led to decreases in both fast-twitch and slow-twitch fiber areas in both muscles, and there was evidence of remodeling of the ultrastructure in both muscles. The activities of beta-hydroxyacyl-CoA dehydrogenase and citrate synthase were reduced during BR, but phosphofructokinase and lactate dehydrogenase activities did not change. The results indicate that 30-d exposure to simulated microgravity decreased the capacity for aerobic energy supply of human skeletal muscle and led to a disorganization of the contractile machinery. I.S.

A89-45508* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
CHARACTERISTICS AND PRELIMINARY OBSERVATIONS OF THE INFLUENCE OF ELECTROMYOSTIMULATION ON THE SIZE AND FUNCTION OF HUMAN SKELETAL MUSCLE DURING 30 DAYS OF SIMULATED MICROGRAVITY
MARC R. DUVOISIN, VICTOR A. CONVERTINO, PAUL BUCHANAN (NASA, Kennedy Space Center, Cocoa Beach, FL), PHILIP A. GOLLNICK (Washington State University, Pullman), and GARY A. DUDLEY (NASA, Kennedy Space Center; Bionetics Corp., Cocoa Beach, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. 671-678. refs
(Contract NAS10-10285)

The effect of transcutaneous electromyostimulation (EMS) on the development of atrophy and the loss of strength in lower limb musculature in humans exposed to microgravity was determined in three subjects who received EMS twice daily in a 3-d on/1-d off cycle on their dominant leg during 30 days of bedrest. The output waveform from the stimulator was sequenced to the knee extensors, knee flexors, ankle extensors, and ankle flexors, and caused three isometric contractions of each muscle group per minute. It was found that, in the dominant leg, EMS acted to attenuate the changes caused by bedrest, such as reductions in the leg volume, muscle compartment size, cross-sectional area of slow- and fast-twitch fibers, strength, and aerobic enzyme activities, and an increase in leg compliance. I.S.

A89-45509
EFFECTS OF PROPRANOLOL ON ACUTE MOUNTAIN SICKNESS (AMS) AND WELL-BEING AT 4,300 METERS OF ALTITUDE
CHARLES S. FULCO, PAUL B. ROCK, JOHN T. REEVES, LAURIE A. TRAD, PATRICIA M. YOUNG (U.S. Army, Research Institute of Environmental Medicine, Natick, MA; Colorado, University, Denver; U.S. Army, Fitzsimons Army Medical Center, Aurora, CO; Millipore Corp., Waters Chromatography Div., Milford, MA) et al. Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. 679-683. refs

The effect of a beta-adrenergic blocking agent, propranolol, on the symptomatology of the acute mountain sickness and on the subjective feeling of well-being were investigated in human subjects during their 19-d-long residence at 4300 m altitude. Subjects received 80 mg propanolol (PRO) or placebo (PLA) at sea level and during the first 15 days of residence at high altitude

and were asked to fill out the Environmental Symptoms Questionnaire (ESQ) twice daily to assess AMS symptoms and subjective feelings. It was found that, throughout the entire altitude exposure, the scores of the ESQ for the PRO group were similar to or lower than those of the PLA group; cessation of PRO treatment did not result in a change in well-being, indicating that interference with the normal acclimatization process by propranolol did not exacerbate AMS. I.S.

A89-45510
TREATMENT OF ESSENTIAL HYPERTENSION WITH YOGA RELAXATION THERAPY IN A USAF AVIATOR - A CASE REPORT
ARTHUR H. BROWNSTEIN (USAF, Regional Medical Center, Clark AFB, Luzon, Philippines) and MARK L. DEMBERT (Naval Hospital, Portsmouth; Eastern Virginia Medical School, Norfolk, VA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. 684-687. refs

A case is reported of a 46-yr-old Caucasian male USAF pilot with a 6-year history of mild essential hypertension for which he was unsuccessfully treated with daily 50-mg doses of hydrochlorothiazide. Despite changes in his lifestyle (he stopped smoking and lost 10 kg of weight through jogging and moderating his caloric intake), his diastolic blood pressure remained high, fluctuating in the range of 86 to 96 mm Hg. After subsequent training and exercises in yoga relaxation, while continuing his routine in dieting and jogging, and gradual reduction of the medication over 3 weks, his diastolic blood pressure returned to normal, and the subject was returned to full flight status without recurrence of diastolic hypertension at followup 6 months later. It is suggested that the relaxation therapy should be considered as a nonpharmacological therapy for medical disorders among flight personnel. I.S.

A89-45511
DEFINING RISK IN AEROSPACE MEDICAL UNCONSCIOUSNESS RESEARCH
JAMES E. WHINNERY (U.S. Navy, Naval Air Development Center, Warminster, PA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. 688-694. refs

Current tactical fighter-type aircraft operate close to human tolerance limits, with the potential for unconsciousness always imminent. The purpose of this paper is to establish standards for defining levels of unconsciousness and to review what is known about the safe limits of exposure of humans to hypoxia resulting from +Gz-force, leading to the loss of consciousness (LOC). The syncope and the G-LOC concepts are defined in the framework of the continuous degradation of the central nervous system (CNS), resulting from hypoxia. Results obtained from animal and human experiments on changes in the CNS underlying the syncope and the LOC during hypoxia are described. Particular attention is given to the safety measures that can be taken to recognize the onset of LOC and to minimize risks connected with +Gz exposure. I.S.

A89-45512
SOVIET SPACE FLIGHT - THE HUMAN ELEMENT
VICTORIA GARSHNEK Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. 695-705. refs

The Soviet manned space missions between 1961 and 1988 are described, with emphasis on the third-generation space station Mir. Particular attention is given to the Soviet manned space program today, including the details of the cosmonaut preparation (selection, training, psychological selection/preparation, and medical training), physiological and psychological measures designed to counteract the effects of a long-term spaceflight (exercise programs, the Penguin suit, the Chibis suit/salt water loading/anti-G suit system, psychological support, nutrition, and the pharmacologic protection), and postflight recovery activities. I.S.

A89-45773
RADIATION HAZARDS TO SPACE CONSTRUCTION - THE ENERGETIC PARTICLE ENVIRONMENT
MICHAEL F. STANFORD and JEFFREY S. SCHLEHER (BDM Corp., Albuquerque, NM) IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 584-595. refs

The paper presents a description of space 'climatology' to provide a basis for evaluating the risk associated with space construction from the energetic particle environment. It has been found that the degree of hazard posed by the energetic particle environment varies with the orbit considered and with the 11-year solar cycle. The primary sources of this environment are the earth's radiation belts, cosmic rays, and solar events. It is suggested that, at the proposed altitude and inclination of the Space Station, these hazards can be minimized by planning. Planning factors include the forecasts of solar proton events and geomagnetic storms and the reduction of EVA in the South Atlantic Anomaly region. B.J.

A89-45812
NON-IONIZING RADIATION EXPOSURE IN SPACE ACTIVITIES
ARTHUR E. SCHULZE (Lovelace Scientific Resources, Webster, TX) IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 1056-1063. refs

Approaches to limit human exposure to nonionizing RF radiation during EVA are examined. Adverse health effects of exposure to RF radiation are listed and the potential exposure sources in space are discussed. Actions that may be taken to reduce the health risks of RF radiation exposure are outlined. It is suggested that terrestrial exposure limits should be evaluated for application to the space environment. R.B.

A89-45826
SURGERY IN THE MICROGRAVITY ENVIRONMENT
PAUL CHASTAIN, MEL DEALIE, and TODD DIERLAM IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 1208-1219. refs

As man becomes more active in space, the possibility of major medical emergencies requiring surgical procedures will increase. Surgery in the microgravity environment involves many challenges not found on earth. Problems such as the flow of intravenous fluids, the operation of suction devices, and the containment of body fluids are key areas of concern. The solutions to these problems require new equipment and expertise. This paper examines these problems and proposes some possible solutions. Author

A89-46058
HYPOXIA SYMPTOMS RESULTING FROM VARIOUS BREATHING GAS MIXTURES AT HIGH ALTITUDE
THOMAS E. NESTHUS (Krug International Corp., Technology Services Div., San Antonio, TX), JOHN B. BOMAR, JR., and RONALD D. HOLDEN (USAF, School of Aerospace Medicine, Brooks AFB, TX) SAFE Journal, vol. 19, Summer 1989, p. 20-26. Research sponsored by USAF. refs

Subjective hypoxia symptoms reported by subjects breathing different oxygen mixtures, before a rapid decompression from 20,000 to 50,000 ft have been compared. The breathing gas mixtures included 100, 93, 90, and 85 percent oxygen, under both the nondilution and the dilution modes of the oxygen regulator. The number of symptoms reported were not appreciably different across concentration conditions. The symptom score data, derived by summing the severity levels of the symptoms reported, showed that the recognition of more pronounced hypoxia did not occur under the most severe 85 percent dilution condition. It is believed that the ability of the individual to recognize the extent of his incapacitation is impaired by the severity of the hypoxic episode

experienced. This impairment effect was most evident under the 85 percent dilution condition. The effect may also confound the results of concentrations producing less severe hypoxia. Author

A89-46061
OBJECTIVE DOCUMENTATION AND MONITORING OF HUMAN GZ TOLERANCE WHEN UNPROTECTED AND WHEN PROTECTED BY ANTI-G SUITS OR M-1 TYPE STRAINING MANEUVERS ALONE OR IN COMBINATION
EARL H. WOOD and EDWARD H. LAMBERT (Mayo Medical Center, Rochester, MN) SAFE Journal, vol. 19, Summer 1989, p. 39-48. refs
(Contract N66001-87-C-0079)

The paper demonstrates the feasibility of developing an unobtrusive miniaturized ear opacity pulse transducer encapsulated in a hearing-aid type mold and remotely controlled from a helmet or cockpit mounted data processing system without wire connections to the pilot. For the purpose of training, this system could be used to activate and modulate the intensity of a red light or an auditory signal in proportion to the amplitude of the ear pulse and to sound a warning signal if the pulse is lost for longer than 2 sec. It is believed that this type of system would be effective in teaching pilots the proper use of anti-G straining maneuvers during centrifuge training. K.K.

A89-46554
FUNCTIONAL STATE OF THE HUMAN OPERATOR - ASSESSMENT AND PREDICTION [FUNKTSIONAL'NOE SOSTOIANIE CHELOVEKA-OPERATORA: OTSENKA I PROGNOZ]
ALEKSANDR B. KOGAN and BORIS M. VLADIMIRSKII Leningrad, Izdatel'stvo Nauka (Problemy Kosmicheskoi Biologii. Volume 58), 1988, 216 p. In Russian. refs

This book considers theoretical and practical aspects related to studies on the space- and time-related organization of the cerebral electrical activity of human operators. Attention is given to the mathematical methods used to analyze psychophysiological experimental data, including the correlation and spectral methods, and to study the cause-effect relationships between various neural centers. Special consideration is given to the techniques and programs used to evaluate the functional state of the operator, to the characteristics of the EEG measurements used to detect relevant functional changes of the operator, and to methods of integral assessment of the functional state. I.S.

A89-47419
EFFECT OF BETA-ADRENOCEPTOR BLOCKADE ON RENIN-ALDOSTERONE AND ALPHA-ANF DURING EXERCISE AT ALTITUDE
PHILIPPE BOUISSOU, JEAN-PAUL RICHALET, FRANCOIS XAVIER GALEN, MARTINE LARTIGUE, PHILIPPE LARMIGNAT (Association pour la Recherche en Physiologie de l'Environnement; Institut National de la Sante et de la Recherche Medicale, Creteil; Limoges, Universite, France) et al. Journal of Applied Physiology (ISSN 0161-7567), vol. 67, July 1989, p. 141-146. Research supported by the Ministere de la Sante and Laboratoire Sandoz. refs

The role of beta-adrenoceptors in hormonal responses to altitude hypoxia was investigated in 12 human subjects treated with a nonselective beta-blocker, pindolol. The subjects performed a standardized maximal bicycle ergometer exercise at sea level or at the altitude of 4350 m, with and without being injected with 15 mg/kg pindolol. During sea-level exercises, pindolol was found to cause a reduction in plasma renin activity (PRA), an increase in plasma alpha-atrial natriuretic factor, but produced no change in plasma aldosterone (PA); at high altitude, the exercise response of PRA was reduced and PA levels were less than at sea level. Administration of pindolol at high altitude completely abolished the exercise-induced elevation in PRA, without an additional decline in PA. Results indicate that PRA is inhibited at high altitude and that beta-adrenoceptors are not responsible for this inhibition. I.S.

N89-25563* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 323)
May 1989 55 p
(NASA-SP-7011(323); NAS 1.21:7011(323)) Avail: NTIS HC A04; NTIS standing order as PB89-912300, $10.50 domestic, $21.00 foreign CSCL 06E

This bibliography lists 125 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during April, 1989. Subject coverage includes; aerospace medicine and psychology, life support systems and controlled environments, safety equipment exobiology and extraterrestrial life, and flight crew behavior and performance. Author

N89-25564# Brigham and Women's Hospital, Boston, MA.
A PROGRAM FOR THE STUDY OF SKELETAL MUSCLE CATABOLISM FOLLOWING PHYSICAL TRAUMA Annual Report, 21 Feb. 1987 - 20 Feb. 1988
DOUGLAS W. WILMORE 15 Mar. 1988 9 p
(Contract DAMD17-86-C-6157; DA PROJ. 351-62772-A-874)
(AD-A206506) Avail: NTIS HC A02/MF A01 CSCL 06/15

These two studies examine the role of prostaglandins as mediators of the catabolic response. In the first study, we examined the effects of a cyclooxgenase inhibition on the catabolic response to operative stress. In a second study we examined the effect of PG2 infusion on skeletal muscle proteolysis. Following laparotomy and retroperitoneal dissection, dogs increase skeletal muscle proteolysis and excrete increased urinary nitrogen. Pretreatment with a cyclooxygenase inhibitor (Ibuprofen) diminished this response in six paired animals when examining whole animal data. Amino acid flux data is presently being processed. In additional studies, PGE2 was infused in one hind limb and the flux of amino acids monitored in both lower extremities. Leg blood flow increased markedly in the limb receiving the PGE2; substrate flux is presently being analyzed. GRA

N89-25565* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 324)
Feb. 1989 70 p
(NASA-SP-7011(324); NAS 1.21:7011(324)) Avail: NTIS HC A03; NTIS standing order as PB89-912300, $10.50 domestic, $21.00 foreign CSCL 06/5

This bibliography lists 200 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during May, 1989. Subject coverage includes: aerospace medicine and psychology, life support systems and controlled environments, safety equipment, exobiology and extraterrestrial life, and flight crew behavior and performance. Author

N89-25566*# Research Inst. for Advanced Computer Science, Moffett Field, CA.
MODELING THE AIDS EPIDEMIC
PETER J. DENNING 22 Sep. 1988 18 p Submitted for publication
(Contract NCC2-387)
(NASA-CR-185413; NAS 1.26:185413; RIACS-TR-88.27) Avail: NTIS HC A03/MF A01 CSCL 06/5

The AIDS epidemic expands relentlessly. In October 1987, the President of the United States requested a national integrated scientific modeling effort to evaluate data already available and guide further data collection to reduce the uncertainties in estimates of prevalence and rates of spread of HIV. In July 1988, a workshop was jointly sponsored by the Office of Science and Technology Policy, Department of Health and Human Services, Department of Energy, and the National Science Foundation in response to this directive. The workshop recommended a variety of measures that add mathematical modeling to the arsenal of weapons that are being developed to defeat HIV, foster and promote collaboration between modelers and other scientists, and encourage individuals and institutions to share data. Perhaps the most important result

of the workshop was a transformation in the way the nearly 100 participants look at the AIDS question: the participants left with a much broader, community-oriented perspective. Author

N89-25567* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 325)
Jul. 1989 68 p
(NASA-SP-7011(325); NAS 1.21:7011(325)) Avail: NTIS HC A04; NTIS standing order as PB89-912300, $10.50 domestic, $21.00 foreign CSCL 06/5

This bibliography lists 192 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during June, 1989. Subject coverage includes: aerospace medicine and psychology, life support systems and controlled environments, safety equipment, exobiology and extraterrestrial life, and flight crew behavior and performance. Author

N89-26376# Northrop Services, Inc., Dayton, OH. Environmental Sciences.
THE 1987 TOXIC HAZARDS RESEARCH UNIT Annual Report, Oct. 1986 - Oct. 1987
WILLIAM E. HOUSTON and RAYMOND S. KUTZMAN Mar. 1988 208 p
(Contract F33615-85-C-0532; AF PROJ. 6302)
(AD-A198097; NMRI-88-11; AAMRL-TR-88-008) Avail: NTIS HC A10/MF A01 CSCL 06/19

A review is presented of the activities of the Toxic Hazards Research Unit. Research focused on toxicity evaluations of aerospace and naval chemicals and materials to include hydraulic fluids, lubricating oils, groundwater contaminants, chemical defense simulants and binary agent components. Physiologically based pharmacokinetic/pharmacodynamic modeling was developed and provides methods for simulating the toxicolgical effects of selected chemicals, including models for chemical carcinogenesis. The completion and utilization of the General Toxicology Laboratory within the THRU has resulted in the completion of an increased number of acute and repeated treatment studies, and additional subchronic studies are planned. Author

N89-26377# Stanford Univ., CA. Dept. of Dermatology.
GAMMA INTERFERON REDUCES THE SYNTHESIS OF FIBRONECTIN BY HUMAN KERATINOCYTES
VERA B. MORHENN, SHELIA T. HUANG, and JONATHAN N. MANSBRIDGE (Psoriasis Research Inst., Stanford, CA.) 6 Oct. 1988 21 p
(Contract N00014-87-K-0216)
(AD-A206645) Avail: NTIS HC A02/MF A01 CSCL 06/1

Recombinant gamma interferon (rIFN-y) has a variety of effects on human keratinocytes including the induction of synthesis and expression of HLA-DR antigen as well as growth inhibition. In order to ascertain whether rIFN-y affects the keratinocytes capacity to interact with other skin cells and potentially alter the composition of skin proteins, we tested the effect of rIFN-y on the secretion of proteins by keratinocytes in vitro. Keratinocytes grown in serum free medium were treated with increasing concentrations of rIFN-y(3 U/ml-1000 U/Ml). The cells were radiolabeled with 35-S-methionine and the supernatants were harvested, excess 35-S-methionine removed, and the proteins analyzed by polyacrylamide gel electrophoresis. The relative synthesis of several proteins was altered by rIFN-y treatment. In particular rIFN-y decreased the synthesis of two proteins, one with a molecular weight of approximately 250 kD and the other 180 kD, and increased the synthesis of an approximately 100 kD protein in a dose dependent manner. Immunoprecipitation with polyclonal anti-fibronectin antibody showed that the 250 kD protein is the fibronectin monomer. No smaller fragments of fibronectin were immunoprecipitated, suggesting that the reduction in extracellular fibronectin following treatment by rIFN-y was not a direct result of proteolytic enzyme digestion. GRA

N89-26378# Federal Aviation Administration, Washington, DC. Office of Aviation Medicine.
PREVALENCE OF DISEASE AMONG ACTIVE CIVIL AIRMEN Final Report
CHARLES F. BOOZE, JR. Oct. 1988 13 p
(AD-A206707; DOT/FAA/AM-89/2) Avail: NTIS HC A03/MF A01 CSCL 06/5

It has been the policy of the Federal Aviation Administration to medically certify, for a variety of flying privileges, individuals who have a medical deficiency or disease, provided it can be determined that such action does not compromise air safety. This descriptive epidemiologic study presents the point prevalence of pathology among 685,552 active airmen as of January 1, 1988, by major body system. The study also presents other selected pathologies of interest within the major body system. Cardiovascular, eye, and abdominal pathologies represent the most prevalent medical conditions among active airmen (7.5 percent, 6.4 percent and 6.3 percent respectively). Hypertension is the most frequently occurring cardiovascular condition. Prevalence of pathology among active civil airmen, while still considerably less than among the general population, is increasing due to recent emphasis on relaxation of regulatory requirements when consistent with safety. GRA

N89-26379# Federal Aviation Administration, Atlantic City, NJ.
AIR TRAFFIC CONTROLLER SCANNING AND EYE MOVEMENTS IN SEARCH OF INFORMATION: A LITERATURE REVIEW Technical Report, Jun. - Dec. 1988
EARL S. STEIN Mar. 1989 30 p
(AD-A206709; DOT/FAA/CT-TN89/9) Avail: NTIS HC A03/MF A01 CSCL 01/5

The Federal Aviation Administration is engaged in an on-going research effort designed to help air traffic controllers reduce the frequency of operational errors. This literature search and review was a first step in the study of controller scanning for information. Results indicate that the study of eye movement is a very complex process even given the current technology available. Another finding is that there has been very little accomplished in the study of air traffic controllers scanning and eye movements. The field is wide open and the potential benefits are large. GRA

N89-26380# Texas Univ., Dallas. Center for Communication Disorders.
THE EFFECTS OF BLAST TRAUMA (IMPULSE NOISE) ON HEARING: A PARAMETRIC STUDY, PART 1 Final Report, 15 Sep. 1983 - 31 Dec. 1985
ROGER P. HAMERNIK, WILLIAM A. AHROON, and GEORGE A. TURRENTINE 21 Jul. 1988 246 p Prepared in cooperation with State Univ. of New York Coll., Plattsburgh
(Contract DAMD17-83-G-9555)
(AD-A206765; ARL-86-2-PT-1) Avail: NTIS HC A11/MF A01 CSCL 06/10

There are three broad goals to this project. The first and primary goal is to begin the systematic development of a database from which one could estimate the hazards to hearing resulting from exposure to blast waves or other high level impulse noise transients. To achieve this primary objective the following two objectives must first be achieved: (1) to develop a methodology to efficiently acquire data ona large number of experimental animals that have been exposed to a variety variables; (2) to develop a set of blast wave simulation devices which can reliably generate blast waves with a variable distribution of spectral energy in an environment. This report will describe progress that was achieved on each of these objectives. The evaluation of hearing consisted of pre- and postexposure measurements of pure tone thresholds and tuning curves (masked thresholds). Quantitative and qualitative data on each experimental cochlea was obtained from the traditional surface preparation technique. GRA

N89-26381# Texas Univ., Dallas. Center for Communication Disorders.
THE EFFECTS OF BLAST TRAUMA (IMPULSE NOISE) ON HEARING: A PARAMETRIC STUDY, PART 2 Final Report, 15 Sep. 1983 - 31 Dec. 1985
ROGER P. HAMERNIK, WILLIAM A. AHROON, and GEORGE A. TURRENTINE 21 Jul. 1988 209 p Prepared in cooperation with State Univ. of New York Coll., Plattsburgh
(Contract DAMD17-83-G-9555)
(AD-A206766; ARL-86-2-PT-2) Avail: NTIS HC A10/MF A01 CSCL 06/10

There are three broad goals to this project. The first and primary goal is to begin the systematic development of a data base from which one could estimate the hazards to hearing resulting from exposure to blast waves or other high level impulse noise transients. To achieve this primary objective the following two objectives must first be achieved: (1) to develop a methodology to efficiently acquire data on a large number of experimental animals that have been exposed to a variety variables; (2) to develop a set of blast wave simulation devices which can reliably generate blast waves with a variable distribution of spectral energy in a laboratory environment. This report will describe progress that was achieved on each of these objectives. The evaluation of hearing consisted of pre- and postexposure measurements of pure tone thresholds and tuning curves (masked thresholds). Quantitative and qualitative preparation technique. GRA

N89-26382# Kansas Univ., Lawrence. Dept. of Speech, Language and Hearing.
DEMODULATION PROCESSES IN AUDITORY PERCEPTION Final Annual Report, 1 Dec. 1987 - 30 Nov. 1989
LAWRENCE L. FETH 3 Jan. 1989 29 p Prepared in cooperation with Ohio State Univ., Columbus
(Contract AF-AFOSR-0091-87; AF PROJ. 2313)
(AD-A207131; AFOSR-89-0468TR) Avail: NTIS HC A03/MF A01 CSCL 06/4

The overall goal of this project is to understand the ability of the human listener to extract information from complex, time-varying sounds such as speech, music or other environmentally important signals. Specifically, we are interested in the listener's ability to process modulations of frequency and amplitude which are thought to carry the information in such signals. To that end we have devised a signal-processing model that calculates the Envelope-Weighted Average of the Instantaneous Frequency (EWAIF) for complex, time-varying signals. We initiated a series of experiments to test the performance of the new EWAIF model. Listeners were asked to discriminate between two frequency modulated tones. Testing of normal listeners in the frequency glide vs multiple-step transition task has indicated that the normal ear has a temporal window of approximately 7 to 10 msec. Further, these results appear to indicate that the critical band, thought to be ubiquitous in peripheral processing, has no effect on the listeners' discriminations of sub-critical, critical or supra-critical bandwidth swept frequency signals. GRA

N89-26383# School of Aerospace Medicine, Brooks AFB, TX.
EVALUATION OF THE SLEEPY CREWMEMBER: USAFSAM EXPERIENCE AND A SUGGESTED CLINICAL APPROACH Interim Report, Nov. 1987 - Apr. 1988
MARC S. KATCHEN and GARY S. GRONSETH Mar. 1989 6 p
(AD-A207151; USAFSAM-JA-88-27) Avail: NTIS HC A02/MF A01 CSCL 05/8

From 1958 to 1986, 27 crewmembers with suspected sleep disorders were referred to the USAF School of Aerospace Medicine. The presenting complaint in most cases was excessive daytime sleepiness (EDS). Prior to 1984, evaluations included neurologic and psychiatric testing, screening laboratory studies, and awake and asleep electroencephalography. Polysomnography and sleep latency studies were included after 1984. In the majority of cases, the etiology of the complaint could not be determined. The prevalence of EDS is estimated to be between 0.3 percent and 4.0 percent of the adult population. Major causes cited in the world literature include the sleep apnea syndromes, narcolepsy, parasomnias interrupting sleep, hypersomnia secondary to systemic or affective disorders, and essential hypersomnia. Current sleep lab techniques and Human Leukocyte Antigen (HLA) typing are reported to make the diagnosis in up to 90 percent of sleep disorders. Evaluation of EDS should begin with a history emphasizing sleep habits, work schedules, daytime naps, and presence of vegetative signs. A sleep diary will allow a more accurate estimate of the quantity of nocturnal sleep. This diary may reveal poor sleep hygiene or insomnia. Polysomnography and/or multiple sleep latency determination can then be used to diagnose sleep apnea, parasomnias, and narcolepsy. GRA

N89-26384# Hebrew Univ., Jerusalem (Israel). Inst. of Physics.
LOW FIRING RATES: AN EFFECTIVE HAMILTONIAN FOR EXCITATORY NEURONS
A. TREVES and DANIEL J. AMIT (Rome Univ., Italy) 16 Jan. 1989 36 p Submitted for publication Sponsored in part by th United States-Israel Binational Science Foundation Prepared in cooperation with Istituto Nazionale di Fisica Nucleare, Rome, Italy
(PREPRINT-652; ETN-89-94726) Avail: NTIS HC A03/MF A01

The behavior of an attractor neural network is analyzed. It exhibits low mean temporal activity levels, despite the fact that the intrinsic neuronal cycle time is very short (2 to 3 ms). An effective model, which describes the interplay of excitation and inhibition acting on excitatory neurons in terms of the excitatory neural variables alone is presented. It is argued that quadratic inhibitions can represent in an effective way both the different dynamical characteristics of inhibitory neurons and the nonlinear operation of inhibitory synapses. ESA

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BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

A89-43712* Texas Univ., Austin.
PERSONALITY AND ORGANIZATIONAL INFLUENCES ON AEROSPACE HUMAN PERFORMANCE
ROBERT L. HELMREICH (Texas, University, Austin) IN: Space - A new community of opportunity; Proceedings of the Thirty-fourth Annual AAS International Conference, Houston, TX, Nov. 3-5, 1987. San Diego, CA, Univelt, Inc., 1989, p. 231-238. refs
(Contract NCC2-286)
(AAS PAPER 87-646)

Individual and organizational influences on performance in aerospace environments are discussed. A model of personality with demonstrated validity is described along with reasons why personality's effects on performance have been underestimated. Organizational forces including intergroup conflict and coercive pressures are also described. It is suggested that basic and applied research in analog situations is needed to provide necessary guidance for planning future space missions. Author

A89-44712
ANALYSIS OF FUNCTIONAL CHARACTERISTICS IN HUMANS FROM THE PATTERNS OF SKIN TEMPERATURE [ANALIZ FUNKTSIONAL'NYKH KHARAKTERISTIK CHELOVEKA PO TEMPERATURNYM PATTERNAM KOZHI]
I. I. ERMAKOVA, A. G. GRIGOR'IAN, and I. M. MOMMADOV (AN USSR, Institut Kibernetiki, Kiev, Ukrainian SSR) Kibernetika i Vychislitel'naia Tekhnika (ISSN 0454-9910), no. 78, 1988, p. 51-54. In Russian. refs

Diagrams of skin-temperature fields, measured at points of eight body regions, were constructed as described by Hayes et al. (1983) for human subjects who were previously adapted to hot climate and were then subjected to different ambient temperatures (21,

28, and 41 C) and humidity (48, 39, and 30 percent, respectively), and the temperature patterns (TPs) constructed for subjects at rest were compared with those obtained during physical exercise. Results showed that the TPs could be grouped into three types, of which one group had the individual TPs in the form of a convex polygon, while the TPs of the other two groups were convex polygons, the differences being due to relatively lower temperatures in the foot and/or hand regions in subjects of these latter groups. Both thermal and physical loads were found to bring about specific changes in the individual TPs, indicating that skin TPs reflect changes imposed on the organism externally (temperature) or internally (exercise). I.S.

A89-45236* San Jose State Univ., CA.
VISUAL ACCELERATION DETECTION - EFFECT OF SIGN AND MOTION ORIENTATION
JACK B. CALDERONE (San Jose State University, CA) and MARY K. KAISER (NASA, Ames Research Center, Moffett Field, CA) Perception and Psychophysics (ISSN 0031-5117), vol. 45, no. 4, 1989, p. 391-394. refs

Thresholds for the detection of constant acceleration and deceleration of a discrete object moving along horizontal and vertical axes were studied. A staircase methodology was used to determine thresholds for three average velocities (0.7, 1.2, and 1.7 deg/sec). Thresholds, expressed as the proportion of velocity change, did not differ significantly among the average velocities; thus, a consistent Weber-like fraction is suggested by the data. Furthermore, there was an interaction between the axis of motion (horizontal or vertical) and the sign of the velocity change (acceleration or deceleration): accelerations were easier to detect along the vertical axis, decelerations along the horizontal axis. Author

A89-45239
PERCEIVED CONTRAST AND STIMULUS SIZE - EXPERIMENT AND SIMULATION
MARK W. CANNON, JR. (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) and STEVEN C. FULLENKAMP (Systems Research Laboratories, Inc., Dayton, OH) Vision Research (ISSN 0042-6989), vol. 28, no. 6, 1988, p. 695-697, 699-709. refs
(AD-A204952; AAMRL-TR-88-033)

Perceived contrast functions were determined for three different Gabor patch sizes using magnitude estimation and verified by contrast matching. While thresholds show a significant decrease with decreasing patch size, perceived contrasts are equal and independent of patch size for contrasts above 0.06. Contrast matching was also used to study the apparent contrast of two other spatially limited stimuli; the sum of two orthogonal 4 c/deg sine waves multiplied by a Gaussian envelope and the sum of spatially adjacent positive and negative Gaussians. Models of contrast perception, based on tuned Gabor spatial filters, were formulated and tested for agreement with experimental data. A model that pools filter responses across spatial frequencies and orientations was found to be more in agreement with data than a model that simply uses the response of a single, maximally excited, mechanism to mediate contrast perception. Optimum filter bandwidth was found to be about 1.1 octaves. Author

A89-45241* Georgia State Univ., Atlanta.
AUTOMATION OF LEARNING-SET TESTING - THE VIDEO-TASK PARADIGM
DAVID A. WASHBURN, WILLIAM D. HOPKINS, and DUANE M. RUMBAUGH (Georgia State University, Atlanta) Behavior Research Methods, Instruments, and Computers (ISSN 0743-3838), vol. 21, no. 2, 1989, p. 281-284. refs
(Contract NAG2-438; NIH-HD-06016)

Researchers interested in studying discrimination learning in primates have typically utilized variations in the Wisconsin General Test Apparatus (WGTA). In the present experiment, a new testing apparatus for the study of primate learning is proposed. In the video-task paradigm, rhesus monkeys (Macaca mulatta) respond to computer-generated stimuli by manipulating a joystick. Using this apparatus, discrimination learning-set data for 2 monkeys were obtained. Performance on Trial 2 exceeded 80 percent within 200 discrimination learning problems. These data illustrate the utility of the video-task paradigm in comparative research. Additionally, the efficient learning and rich data that were characteristic of this study suggest several advantages of the present testing paradigm over traditional WGTA testing. Author

A89-45348
FAILING AVIATOR SYNDROME - A CASE HISTORY
VICTORIA M. VOGE (U.S. Navy, Naval Hospital, Corpus Christi, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. A89-A91. refs

The characteristics of the 'failing aviator' syndrome are discussed, using the case history of a naval pilot involved in a fatal aircraft mishap, in whom the symptoms of the failing aviator syndrome should have been recognized long before the fatal mishap. An examination revealed that this pilot exhibited most of the personality traits listed by Reinhardt (1966, 1967) and Alkov et al. (1982 and 1985) as characteristic for a failing aviator. Typically, the failing aviators may exhibit some of the following characteristics: having no sense of own limitations, acting out his problems, be very sensitive to criticism, overcompensating, be argumentive or arrogant, use denial, be defensive or angry with demands and/or responsibilities, have moved sharply up or down in life, have experienced a recent change in personality, and have problems with peers and/or interpersonal relationships. I.S.

A89-47329
ASSESSMENT OF PILOT WORKLOAD DURING BOEING 767 NORMAL AND ABNORMAL OPERATING CONDITIONS
A. H. ROSCOE and B. S. GRIEVE (Britannia Airways, Ltd., Luton, England) IN: Aerospace Behavioral Technology Conference and Exposition, 7th, Anaheim, CA, Oct. 3-6, 1988, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1989, p. 37-41. refs
(SAE PAPER 881382)

A simulator was used to assess the levels of pilot workloads generated by flight failures and emergencies in the B767 aircraft and to compare these workload levels with those generated during normal operations. Workload ratings were used in conjunction with recordings of pilots' heart rates. Results obtained suggest that levels of workload associated with flight failures and emergencies in the B767 are quite acceptable for well-trained line pilots. I.S.

A89-47330
ASSESSMENT OF CREW WORKLOAD PROCEDURES IN FULL FIDELITY SIMULATION
WILLIAM H. CORWIN, MICHAEL A. BIFERNO, S. A. METALIS, JON E. JOHNSON (Douglas Aircraft Co., Long Beach, CA), DIANE L. SANDRY-GARZA (Boeing Commercial Airplanes, Seattle, WA) et al. IN: Aerospace Behavioral Technology Conference and Exposition, 7th, Anaheim, CA, Oct. 3-6, 1988, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1989, p. 43-50. refs
(SAE PAPER 881383)

Various assessment techniques for collecting flight deck workload for new aircraft certification are presented. Workload assessment techniques include subjective, physiological, and performance measures. Measurement of segment length as well as data collection, reduction, and analysis are discussed. Sample results from a full-fidelity simulation study are presented as examples for the techniques discussed. Author

A89-47331
THE EFFECTS OF HIGH INFORMATION PROCESSING LOADS ON HUMAN PERFORMANCE
DIANE DAMOS (Southern California, University, Los Angeles, CA) IN: Aerospace Behavioral Technology Conference and Exposition, 7th, Anaheim, CA, Oct. 3-6, 1988, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1989, p. 51-54. refs
(Contract N0014-86-K-0119)
(SAE PAPER 881384)

This paper examines the effect of high information processing loads on human performance. It begins with a brief review of models of human information processing, followed by a discussion of methods operators commonly adopt to reduce their information processing load. Finally, methods of reducing the effect of high loads on system performance through selection and training are described. Author

A89-47332* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ASSESSMENT OF PILOT WORKLOAD WITH THE INTRODUCTION OF AN AIRBORNE THREAT-ALERT SYSTEM
VERNOL BATTISTE (NASA, Ames Research Center, Moffett Field, CA) and MICHAEL R. BORTOLUSSI (Western Aerospace Laboratories, Inc., Moffett Field, CA) IN: Aerospace Behavioral Technology Conference and Exposition, 7th, Anaheim, CA, Oct. 3-6, 1988, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1989, p. 55-61. refs
(SAE PAPER 881385)

Simulated line operations were used to assess the value of the TCAS on the pilot's ability to avoid a collision and to determine the effects of various display configurations and information contents on the flight-crew performance and workload. The crew flew a Phase II Link/Boeing 727 simulator in a simulated ATC environment. Four levels of collision avoidance information were evaluated using the following TCAS display formats: no TCAS information, TCAS information with no traffic display information, TCAS information with threat-activated traffic display information, and TCAS information with a full-time traffic display of threat information. It was found that the use of a threat-activated TCAS display significantly reduced the first officers' workload was significantly reduced by the threat-activated TCAS display, as were the workloads of the captain and the second officer. I.S.

A89-47333
SITUATIONAL AWARENESS IN THE COMMERCIAL FLIGHT DECK - DEFINITION, MEASUREMENT, AND ENHANCEMENT
DAVID M. REGAL, WILLIAM H. ROGERS, and GEORGE P. BOUCEK, JR. (Boeing Commercial Airplanes, Seattle, WA) IN: Aerospace Behavioral Technology Conference and Exposition, 7th, Anaheim, CA, Oct. 3-6, 1988, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1989, p. 65-69. refs
(SAE PAPER 881508)

This paper provides an indepth examination of the concept of pilot situational awareness. A detailed definition of the concept is provided, examining both the components that make up situational awareness and its dynamic aspects. The supposed benefits of enhanced situational awareness are described. These include: improved safety, reduced workload, enhanced pilot performance, expanded range of pilot operations, and improved decision-making. The question of measurement is next considered. Both the direct measurement of situational awareness and the measurement of pilot performance are addressed. The paper ends with a discussion of methods for enhancing situational awareness. Author

N89-25568*# Ohio State Univ., Columbus. Dept. of Industrial and Systems Engineering.
THE ORGANIZATION OF PERCEPTION AND ACTION IN COMPLEX CONTROL SKILLS Final Report
RICHARD A. MILLER and RICHARD J. JAGACINSKI May 1989 300 p
(Contract NAG2-195)
(NASA-CR-184638; NAS 1.26:184638) Avail: NTIS HC A13/MF A01 CSCL 05/9

An attempt was made to describe the perceptual, cognitive, and action processes that account for highly skilled human performance in complex task environments. In order to study such a performance in a controlled setting, a laboratory task was constructed and three experiments were performed using human subjects. A general framework was developed for describing the organization of perceptual, cognitive, and action process. Author

N89-25569# Los Alamos National Lab., NM.
ADAPTIVE ENHANCEMENT OF MAGNETOENCEPHALOGRAPHIC SIGNALS VIA MULTICHANNEL FILTERING
PAUL S. LEWIS 1989 5 p Presented at the International Conference on Acoustics, Speech and Signal Processing, Glasgow, Scotland, 23 May 1989
(Contract W-7405-ENG-36)
(DE89-005464; LA-UR-88-4190; CONF-890570-1) Avail: NTIS HC A02/MF A01

A time-varying spatial/temporal filter for enhancing multichannel magnetoencephalographic (MEG) recordings of evoked responses is described. This filter is based in projections derived from a combination of measured data and a priori models of the expected response. It produces estimates of the evoked fields in single trial measurements. These estimates can reduce the need for signal averaging in some situations. The filter uses the a priori model information to enhance responses where they exist, but avoids creating responses that do not exist. Examples are included of the filter's application to both MEG single trial data containing an auditory evoked field and control data with no evoked field. DOE

N89-26385# Systems Research Labs., Inc., Dayton, OH.
THE USE OF PSYCHOPHYSIOLOGICAL MEASURES IN THE SABER LABORATORIES, PHASE 1 Interim Report, Nov. 1987 - Aug. 1988
KATHY MCCLOSKEY, MELODIE MORROW, and WILLIAM A. PEREZ 3 Oct. 1988 68 p
(Contract F33615-85-C-0541)
(AD-A206825; AAMRL-TR-88-052) Avail: NTIS HC A04/MF A01 CSCL 05/8

Behavioral and psychophysiological measures were obtained during a low-fidelity F-15 flight simulation where subjects were required to fly the wing position in relation to a canned lead flight. One of the major emphases of this preliminary research effort was to identify, solve and document the hardware/software problems that emerged when a physiological data collection device (the Neuropsychological Workload Test Battery) was interface with a computer controlling the simulation (Silicon Graphics device). Another emphasis was determining the cost-effectiveness of psychophysiological measurement in term of value of the data. This study demonstrated that heart rate and eyeblink data not only confirmed and further clarified information obtained by the behavioral measure, but also provided information about the flight task not otherwise available. It was concluded that, in future SABER simulations, the extra costs of collecting physiological data are offset by the increased dimensionality and extra information added to the flight profile database. GRA

N89-26386# California Univ., Berkeley. Dept. of Psychology.
VISUAL INFORMATION-PROCESSING IN THE PERCEPTION OF FEATURES AND OBJECTS Annual Report No. 2, 1 Jan. - 31 Dec. 1988
ANNE TREISMAN 5 Jan. 1989 157 p
(Contract AF-AFOSR-0125-87; AF PROJ. 2313)
(AD-A206948; AFOSR-89-0403TR) Avail: NTIS HC A08/MF A01 CSCL 05/8

This research supported by my grant from AFOSR this year completed some of the projects outlined in the first annual report and initiated some new ones. The focus remained on the visual processing of features and objects, the role of spatial attention and the representation of complex visual patterns in perception and memory. Studies of visual search explored the coding of features at potentially more abstract levels than simple luminance filters: Among the features studied were orientation (for lines, dot pairs and edges), orientation and size (for shapes whose boundaries were defined by discontinuities of texture, motion and depth), and illusory contours. Another series of experiments tested the mechanisms underlying the coding of feature conjunctions, using evidence from search latencies and illusory conjunction errors. The results led to a proposed revision of my earlier feature integration theory. Two other studies looked at memory for visual

patterns. One studied the effects of prolonged practice (thousands of trials) on the coding of visual patterns. At the other extreme, an experiment explored the effects on memory just one to five presentations of similar patterns. In both cases, we found striking specificity in the coding of these meaningless shapes and in their effects on subjects' later experiences with the same stimuli.
GRA

N89-26387# California Univ., Irvine. Computational Intelligence Project.
RULES AND PRINCIPLES IN COGNITIVE DIAGNOSIS Interim Report, 1 Jan. - 31 Dec. 1988
PAT LANGLEY, JAMES WOGULIS, and STELLAN OHLSSON (Pittsburgh Univ., PA.) 1 Jan. 1989 37 p
(Contract N00014-85-K-0373)
(AD-A207041; UCI-ICS-TR-89-02; TR-6) Avail: NTIS HC A03/MF A01 CSCL 12/9

Cognitive simulation is concerned with constructing process models of human cognitive behavior. The authors' work on the ACM (Automated Cognitive Modeler) is an attempt to automate this process. The basic assumption is that all goal-oriented cognitive behavior involves search through some problem space. Within this framework, the task of cognitive diagnosis is to identify the problem space in which the subject is operating, identify solution paths used by the subject, and find conditions on the operators that explain those solution paths that predict the subject's behavior on new problems. The work presented in this paper uses techniques from machine learning to automate the tasks of finding solution paths and operator conditions. The authors apply this method to the domain of multi-column subtraction and present results that demonstrate ACM's ability to model incorrect subtraction strategies. Finally, they discuss the difference between procedural bugs and misconceptions, proposing that errors due to misconceptions can be viewed as violations of principles for the task domain. GRA

N89-26388# South Carolina Univ., Columbia. Dept. of Psychology.
WORKING MEMORY CAPACITY: AN INDIVIDUAL DIFFERENCES APPROACH Final Report, 1 Jan. 1987 - 30 Dec. 1988
RANDALL W. ENGLE 27 Feb. 1989 23 p
(Contract AF-AFOSR-0069-87; AF PROJ. 2313)
(AD-A207127; AFOSR-89-0464TR) Avail: NTIS HC A03/MF A01 CSCL 05/8

A research program is described which addresses several issues about the role of individual differences in working memory and reading comprehension. The studies show a strong positive relationship between measures of working memory capacity and higher level measures of comprehension. More importantly, this relationship does not require that the working memory measure be a form of the comprehension measure. At least one variable known to be important in simple word span, word length, is also important to the complex working memory measures used here and elsewhere and this has important implications for theories about the link between working memory and higher level tasks, at least those of a verbal nature. GRA

N89-26389# Virginia Univ., Charlottesville. Dept. of Psychology.
PERCEPTUAL CONSTRAINTS ON UNDERSTANDING PHYSICAL DYNAMICS Final Report, 1 Jun. 1987 - 31 Dec. 1988
DENNIS R. PROFFITT and DAVID L. GILDEN 28 Feb. 1989 35 p
(Contract AF-AFOSR-0238-88; AF PROJ. 2313)
(AD-A207129; AFOSR-89-0452TR) Avail: NTIS HC A03/MF A01 CSCL 05/8

When making dynamical judgments, effective use can be made of one salient dimension of information present in the event. Dynamical judgments are not made by deriving multidimensional quantities. Thus, the adequacy of dynamical judgments depends on the degree of dimensionality that is both: (1) inherent in the physics of the event, and (2) presumed to be present by the observer. Support for this proposal was found in studies of dynamical understandings of wheels, volume displacements (Archimedes Principle), the surface orientation of liquids, and collisions. Additional support was found in a review of the Intuitive Physics literature. Finally, studies of apparent motion indicate that the basic representation of object motions is not dynamical.
GRA

N89-26390 Politecnico di Milano (Italy). Laboratorio di Calcolatori.
MODELING HUMAN BEHAVIOR FOR EFFECTIVE PERSON-MACHINE INTERFACES: KNOWLEDGE REPRESENTATION ISSUES
ANDREA BONARINI Mar. 1989 17 p
(REPT-89-032; ETN-89-94973) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The importance of modeling human behavior in order to build Person-Machine Interfaces (PMI) behaving in a suitable way is discussed. It is argued that a PMI not only has to be able to manage a user model, but it must behave as a human being, too. The most effective way to obtain that is to build a PMI based on the same model used to represent human behavior. The PANDA computer system, based on these principles and working on the pragmatic aspects of person-machine dialog, is presented. Knowledge representation and inference are discussed. An example showing the characteristics of this system is outlined. The PANDA is implemented in COMMON LISP and CLOS. ESA

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

A89-43713* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
BIO-REGENERATIVE LIFE SUPPORT
ROBERT D. MACELROY and THEODORE WYDEVEN, JR. (NASA, Ames Research Center, Moffett Field, CA) IN: Space - A new community of opportunity; Proceedings of the Thirty-fourth Annual AAS International Conference, Houston, TX, Nov. 3-5, 1987. San Diego, CA, Univelt, Inc., 1989, p. 239-252. refs
(AAS PAPER 87-647)

The basis for and the potential uses of bio-regenerative life support are examined. Bio-regenerative life support systems are an alternative to physical-chemical regeneration techniques for use when resupply of a crew in space is expensive, or when the logistics of resupply are difficult. Many of the scientific studies required for bio-regenerative life support systems have been completed and preliminary development of some components will begin within the next 12 to 18 months. The focus of the work that lies ahead will be efficient power and mass use, long-term system stability, component function, systems integration, and extensive testing in the space environment. Because of the advantages of bio-regeneration, it is anticipated that human life support for long-term space missions will evolve to include increasingly large amounts of biologically-based regeneration.
Author

A89-43720* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE STATION INITIAL OPERATIONAL CONCEPT (IOC) OPERATIONS AND SAFETY VIEW - AUTOMATION AND ROBOTICS FOR SPACE STATION
WILLIAM V. BATES, JR. (NASA, Johnson Space Center, Houston, TX) IN: Space - A new community of opportunity; Proceedings of the Thirty-fourth Annual AAS International Conference, Houston, TX, Nov. 3-5, 1987. San Diego, CA, Univelt, Inc., 1989, p.

349-354.
(AAS PAPER 87-667)

The automation and robotics requirements for the Space Station Initial Operational Concept (IOC) are discussed. The amount of tasks to be performed by an eight-person crew, the need for an automated or directed fault analysis capability, and ground support requirements are considered. Issues important in determining the role of automation for the IOC are listed. R.B.

A89-44296* Texas A&M Univ., College Station.
ANALYSIS OF AN ALGAE-BASED CELSS. I - MODEL DEVELOPMENT
MARK T. HOLTZAPPLE, FRANK E. LITTLE, MERRY E. MAKELA, and C. O. PATTERSON (Texas A & M University, College Station) Acta Astronautica (ISSN 0094-5765), vol. 19, April 1989, p. 353-364. refs
(Contract NAG9-161)

A steady state chemical model and computer program have been developed for a life support system and applied to trade-off studies. The model is based on human demand for food and oxygen determined from crew metabolic needs. The model includes modules for water recycle, waste treatment, CO2 removal and treatment, and food production. The computer program calculates rates of use and material balance for food, O2, the recycle of human waste and trash, H2O, N2, and food production/supply. A simple noniterative solution for the model has been developed using the steady state rate equations for the chemical reactions. The model and program have been used in system sizing and subsystem trade-off studies of a partially closed life support system. Author

A89-44297* Texas A&M Univ., College Station.
ANALYSIS OF AN ALGAE-BASED CELSS. II - OPTIONS AND WEIGHT ANALYSIS
MARK T. HOLTZAPPLE, FRANK E. LITTLE, WILLIAM M. MOSES, and C. O. PATTERSON (Texas A & M University, College Station) Acta Astronautica (ISSN 0094-5765), vol. 19, April 1989, p. 365-375. refs
(Contract NAG9-161)

Life support components are evaluated for application to an idealized closed life support system which includes an algal reactor for food production. Weight-based trade studies are reported as 'break-even' time for replacing food stores with a regenerative bioreactor. It is concluded that closure of the life support gases (oxygen recovery) depends on the carbon dioxide reduction chemistry and that an algae-based food production can provide an attractive alternative to re-supply for longer duration missions. Author

A89-44646#
THE EUROPEAN SPACE SUIT AND EXTRA VEHICULAR ACTIVITIES - NEW OPPORTUNITIES FOR MANNED SPACE ACTIVITIES IN EUROPE
AKE INGEMAR SKOOG, MARTIN DIENER, REINHARD LOEWENS, ROLAND VAETH, and EBERHARD ACHTERMANN Dornier Post (ISSN 0012-5563), no. 2, 1989, p. 100-105.

The EVA system developed by EVA, and the European space suit which will be a key element in the system, are discussed. The Suit Enclosure Module and Life Support Module of the Space Suit are described, the major functions of the EVA life support system are shown, and the EVA life support system module baseline is diagrammed. The Information and Communication Module which provides information and control function to the EVA astronaut is discussed. C.D.

A89-45345
U.S. ARMY ANTHROPOMETRIC STANDARDS FOR ROTARY-WING AVIATORS IN THE LIGHT OBSERVATION HELICOPTER
W. D. FARR (U.S. Army, Brook Army Medical Center, Fort Sam Houston, TX) and T. M. BUESCHER (U.S. Army, Walter Reed Medical Center, Washington, DC) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, July 1989, p. A74-A76. refs

The U.S. Army standard anthropometric measurements for rotary-wing aircraft personnel were applied to 30 rated pilots with heights of not greater than 70 in. to determine whether these standards allow an adequate fit of the pilot to the cockpit of the OH-58A 'Kiowa' light observation helicopter, and the ability of the pilot to reach all control surfaces and panel switches. It was found that the present U.S. Army standards do not address adequately the functional ability in the OH-58A cockpit, which is the least adjustable cockpit in the combat inventory. Some pilots less than 68 in. in height could not perform all cockpit tasks in the OH-58A, without necessitating cockpit changes beyond the limited adjustments; several pilots with heights over 68 in. (and, therefore, not subject to anthropometric testing upon entry into the U.S. Army aviation) were seen to have similar problems. I.S.

A89-45748
A PHASED APPROACH TO LUNAR-BASED AGRICULTURE
TOM POLETTE and LARRY TOUPS (Houston, University, TX) IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 287-297. refs

A three-phase approach to lunar-based agriculture is presented which incorporates research on crop optimization. A first-phase facility would utilize both a hard module for systems equipment and an inflatable structure providing a growth chamber for the demonstration of crop production. In the second phase, additional facilities would be installed to allow for the production of warm season crops and to support the entire crew. The third phase would use in situ lunar materials to construct a larger inflatabale growth facility. B.J.

A89-45749
EXTRATERRESTRIAL APPLICATION OF SOLAR OPTICS FOR INTERIOR ILLUMINATION
DAVID A. EIJADI and KYLE D. WILLIAMS (BRW, Inc., Minneapolis, MN) IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 298-309. refs

Two beamed sunlighting systems are discussed: passive solar optics (PSO) and active solar optics (ASO). ASO and PSO are systems for transmitting sunlight to remote interior spaces; ASO is most appropriate for task illumination, while PSO is most appropriate for general illumination. Particular attention is given to the prism light guide, a solar optic component which has been identified as having potential for use in the Space Station CELSS modules and on lunar bases. A first attempt to identify potential uses of solar optic technology for interior illumination of several lunar base concepts is presented. B.J.

A89-45753
LUNAR AGRICULTURAL REQUIREMENTS DEFINITION
JUDITH FIELDER and NICKOLAUS LEGGETT IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 344-349.

Requirements are presented for an agricultural system that would supply a lunar base. This agricultural system consists of plant growth units established within pressurized modules. Each module is located below the surface of the lunar regolith. Aeroponic, hydroponic, or soil-based systems are used in modified environmental conditions. Specific design factors for each system are presented. Author

A89-45762* Lockheed Missiles and Space Co., Sunnyvale, CA.
DESIGN REQUIREMENTS FOR A MARS BASE GREENHOUSE
STEVEN H. SCHWARTZKOPF (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) and ROCCO MANCINELLI (NASA, Ames Research Center, Moffett Field, CA) IN: Engineering, construction,

and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 447-456. refs

One potential method of supplying life support to a manned base on Mars utilizes a Controlled Ecological Life Support Systems (CELSS). A major component of the CELSS is a plant growth unit to produce food. This paper describes the results of several experiments conducted to determine whether or not a low atmospheric pressure greenhouse could be used to grow crop plants on the Martian surface. The results of these experiments are described and integrated with other information to produce a set of design requirements and a conceptual design for such a greenhouse. Author

A89-45777* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

TELEROBOTICS DESIGN ISSUES FOR SPACE CONSTRUCTION

JEFFREY H. SMITH, MAX GYAMFI, KENT VOLKMER, and WAYNE ZIMMERMAN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 644-655. refs

(Contract NAS7-918)

The use of a Flight Telerobotic Servicer (FTS) in the construction of the Space Station is examined. A methodology is presented for evaluating possible construction tasks, telerobotic performance capabilities, development costs, and operational constraints. The use of telerobotics as a substitute for human EVA activities and the construction tasks which an FTS could perform in the next 8-10 years are considered. The cost-effectiveness of construction using the FTS is compared with that of construction using the STS. The trade-offs associated with using the FTS are discussed in detail. R.B.

A89-45778* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

ROBOTIC SPACE CONSTRUCTION

RANDOLPH W. MIXON, WALTER W. HANKINS, III (NASA, Langley Research Center, Hampton, VA), and MARION A. WISE (Wise Technical Services, Hampton, VA) IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 656-669. refs

Research at Langley AFB concerning automated space assembly is reviewed, including a Space Shuttle experiment to test astronaut ability to assemble a repetitive truss structure, testing the use of teleoperated manipulators to construct the Assembly Concept for Construction of Erectable Space Structures I truss, and assessment of the basic characteristics of manipulator assembly operations. Other research topics include the simultaneous coordinated control of dual-arm manipulators and the automated assembly of candidate Space Station trusses. Consideration is given to the construction of an Automated Space Assembly Laboratory to study and develop the algorithms, procedures, special purpose hardware, and processes needed for automated truss assembly. R.B.

A89-45780

ROBOTICS RESEARCH FOR CONSTRUCTION IN SPACE

IRVING J. OPPENHEIM (Carnegie-Mellon University, Pittsburgh, PA) IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 679-690. Research sponsored by the U.S. Bureau of Mines, DOE, Electric Power Research Institute, and NSF. refs

Research in construction robotics, terrestrial or otherwise, has focused on issues which are broadly pertinent to space applications. Construction robotics is distinguished by a demand for cognitive capabilities because of the unstructured domain and the additional necessity to generate task plans on the basis of information from the force domain and the spatial domain. Substantial progress has been made on six separate research programs, all conducted in the contexts of civil engineering, architecture, or construction: inertia effects in manipulation, control of flexible manipulators, force cognitive manipulation, domain modelling, spatial reasoning, and domain specific task planning. For each program the challenge is described, the results summarized, and the pertinence to space applications stated. Author

A89-45781* Lockheed Engineering and Management Services Co., Inc., Houston, TX.

ROBOTIC INFLUENCE IN THE CONCEPTUAL DESIGN OF MECHANICAL SYSTEMS IN SPACE AND VICE VERSA - A SURVEY

GEORGE F. SANGER (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 691-701.

(Contract NAS9-17900)

A survey of methods using robotic devices to construct structural elements in space is presented. Two approaches to robotic construction are considered: one in which the structural elements are designed using conventional aerospace techniques which tend to constrain the function aspects of robotics and one in which the structural elements are designed from the conceptual stage with built-in robotic features. Examples are presented of structural building concepts using robotics, including the construction of the SP-100 nuclear reactor power system, a multimirror large aperture IR space telescope concept, retrieval and repair in space, and the Flight Telerobotic Servicer. R.B.

A89-45786

ADAPTABLE CREW FACILITIES FOR FUTURE SPACE MODULES

DAVID NIXON (Future Systems Consultants, Los Angeles, CA), CHRISTOPHER MILLER, and REGIS FAUQUET IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 750-761. refs

Studies at NASA-Ames Research Center on advanced crew accommodation features for the Space Station are discussed. Life-size interior module crew environments and facilities and prototype accommodation features have been constructed for the habitability and laboratory modules. The general accommodation concept is outlined and the utility systems and distribution, structural spine, attachments, and rack and compartment geometry are described. Emphasis is placed on research to improve the habitability of the modules. R.B.

A89-45790

THE ROLE OF A MOBILE TRANSPORTER IN LARGE SPACE STRUCTURES ASSEMBLY AND MAINTENANCE

R. W. ADKISSON (McDonnell Douglas Astronautics Co., Space Station Div., Huntington Beach, CA) IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 787-796.

The phased Space Station Mobile Transporter (MT) is examined as a representative support vehicle for large space structures. The functional and interface design requirements are summarized, and the MT system is described, listing values for the most important MT capabilities. The MT operations with respect to the assembly work platform, Space Station assembly, and Space Station service and maintenance are addressed. Alternate applications of the MT system or subsystems as an autonomous transporter, to space travel vehicle support, and to lunar bases are discussed. C.D.

A89-45807

SUPERCRITICAL WATER OXIDATION - SPACE APPLICATIONS

GLENN T. HONG, WILLIAM R. KILLILEA, and TERRY B. THOMASON (Modar, Inc., Natick, MA) IN: Engineering,

construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 987-998. refs

The process of supercritical water oxidation (SCWO) is approaching terrestrial commercialization for the destruction of toxic and hazardous waste chemicals. The technology appears promising for use in space applications, where its primary functions would be aqueous waste treatment, potable water product, and possibly facility atmosphere purification. The present paper discusses some of the considerations for the use of SCWO in space facilities. Author

A89-45808* Bend Research, Inc., OR.
DEVELOPMENT OF A TWO-STAGE MEMBRANE-BASED WASH-WATER RECLAMATION SUBSYSTEM
S. B. MCCRAY (Bend Research, Inc., OR) IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 999-1010. refs
(Contract NAS9-17031; NAS9-17523)

A two-stage membrane-based subsystem was designed and constructed to enable the recycle of wash waters generated in space. The first stage is a fouling-resistant tube-side-feed hollow-fiber ultrafiltration module, and the second stage is a spiral-wound reverse-osmosis module. Throughout long-term tests, the subsystem consistently produced high-quality permeate, processing actual wash water to 95 percent recovery. Author

A89-45809
WASTE MANAGEMENT - PROJECT MERCURY TO THE SPACE STATION
ANTHONY WACHINSKI (U.S. Air Force Academy, Colorado Springs, CO) IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 1011-1020. refs

The design of a waste management system for manned space flights is considered on the basis of the results of waste management studies published by NASA and other sources. The evolution of the waste management system is followed, from the systems on board the Project Mercury and Project Gemini through Apollo, Skylab, and Space Shuttle Orbiter, with particular consideration given to the waste collection, waste management, water management, and storage subsystems. The constraints on the special features in the design of the Space Station waste management system are examined. I.S.

A89-45810
PLASMA REACTOR WASTE MANAGEMENT SYSTEMS
ROBERT O. NESS, JR., JOHN R. RINDT, and SUMITRA R. NESS (North Dakota, University, Grand Forks) IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 1021-1032. refs

The development of a plasma reactor system for use in closed-loop processing of biological, manufacturing, and waste materials, is discussed. The system uses dc, high-frequency, or microwave discharges to produce plasmas for treating the materials. A batch plasma reactor was used to oxidize human fecal material, sunflowers, oats, soybeans and plastics. The system converted over 98 percent of the organic material to gaseous products. Analysis of the remaining solids showed large amounts of water and acid-soluble materials that could possibly be used as nutrients for biological systems. R.B.

A89-45811
WASTEWATER RECYCLE/REUSE - LESSONS-LEARNED FROM USA-CERL RESEARCH AND DEVELOPMENT
RICHARD J. SCHOLZE, JR. and ED D. SMITH (U.S. Army, Construction Engineering Research Laboratory, Champaign, IL) IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 1033-1043. refs

Ultimate acceptance of water recycle/reuse by the scientific community is a function of rigorous data collection and successful demonstration regarding health effects. An uncomplicated, workable field laundry and shower wastewater recycling system with the potential to save substantial amounts of water under arid field conditions has been developed. Development of the system has been paralleled by a primary focus on the health considerations of using the recycled water. Direction for future research and developemnt is presented in a generic format to ensure appropriate data are collected to answer health related questions. Author

A89-45813
SPACE OPERATIONS - CARE AND HANDLING OF REMAINS
C. R. BEAUCHEMIN (USAF, Engineering and Services Center, Tyndall AFB, FL) IN: Engineering, construction, and operations in space; Proceedings of the Space '88 Conference, Albuquerque, NM, Aug. 29-31, 1988. New York, American Society of Civil Engineers, 1988, p. 1064-1070.

Consideration is given to the design and development of facilities and equipment for the care and handling of human remains (corpses) in space operations. The options for holding unembalmed remains and the space and equipment requirements for an embalming room on a spacecraft are discussed. The available alternatives for recovering remains in space, transferring remains from space to a preparation/holding facility or from one facility to another, and transporting remains from a space mortuary to earth are examined. R.B.

A89-46059
A DEVELOPMENTAL SYSTEM FOR PROTECTION FROM G-INDUCED LOSS OF CONSCIOUSNESS
D. A. FISHER, M. I. DARRAH, G. W. CAMPBELL, and K. G. MATHEWS (McDonnell Aircraft Co., Saint Louis, MO) SAFE Journal, vol. 19, Summer 1989, p. 28-32.

The development of a loss of consciousness monitoring and recovery system (LOC-MARS) which can be integrated into present and future fighter-attack aircraft is discussed. LOC-MARS reliably detects temporary aircrew incapacitation and generates a binary discrete which may either command an aircraft automatic recovery sequence or provide an auditory and/or visual signal to the aircrew or instructor pilot. LOC-MARS comprises the following input categories: aircrew physiological state, aircraft state, and a G-time history, or 'risk predictor' algorithms. K.K.

A89-46060
NEW IMPROVEMENTS TO COMMUNICATIONS AND HEARING PROTECTION IN HIGH NOISE ENVIRONMENTS
ROY W. GAMBLIN and K. ALAN HALL (Helmets, Ltd., Saint Albans, England) SAFE Journal, vol. 19, Summer 1989, p. 33-38.

Devices being developed to improve hearing protection and communication in the high noise environment are described. Noise canceling microphones are described as well as a voice-operated switch (VOS). In the case of the VOS, the problem of first syllable switching is solved by introducing a short electronic delay into the speech path to allow time for the VOS operate. K.K.

A89-46293#
DYNAMIC MATHEMATICAL MODEL OF THERMODYNAMICS OF 'HUMAN-CABIN'
HUISHAN HE, RONGZHONG SHOU, and XIAOJIANG XU (Beijing University of Aeronautics and Astronautics, People's Republic of China) Acta Aeronautica et Astronautica Sinica (ISSN 1000-6893), vol. 10, April 1989, p. B155-B163. In Chinese, with abstract in English.

The dynamic mathematical model of thermodynamics on 'human-cabin' has been presented by considering an integral system of cabin and human. The physiological data used in the model were obtained from tests, and the empirical formulas used in the model were checked with tests. Based on the model, several thermophysiological indices for the pilot in a cabin can be predicted and the cooling or heating capacity and the other parameters of

an air conditioning system can be determined. As an example, the dynamic characteristics of the temperature within the cabin of a fighter in a typical flight profile and the thermophysiological indices for the pilot set in it were predicted. Author

A89-46497
MODELING HUMAN ERRORS IN REPAIRABLE SYSTEMS
BALBIR S. DHILLON (Ottawa, University, Canada) IN: Annual Reliability and Maintainability Symposium, Atlanta, GA, Jan. 24-26, 1989, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1989, p. 418-424. refs

The author presents the reliability analysis of repairable and nonrepairable redundant systems with human errors and common-cause failures. Parallel, k-out-of-n, and standby systems are studied. Reliability, mean-time-to-failure, steady-state availability, and variance-of-time-to-failure formulas are developed. Some plots are presented. The plots clearly demonstrate that system steady-state availability, mean-time-to-failure, and reliability decrease with increasing values of human error rate. I.E.

A89-47327
FLIGHT CREW DISPLAYS FOR SPACE STATION PROXIMITY OPERATIONS
JOHN B. LAUGER, PAUL J. GEERY, and GEORGE L. MURPHY (*McDonnell Douglas Astronautics Co., Huntington Beach, CA*) IN: Aerospace Behavioral Technology Conference and Exposition, 7th, Anaheim, CA, Oct. 3-6, 1988, Proceedings. Warrendale, PA, Society of Automotive Engineers, Inc., 1989, p. 21-27.
(SAE PAPER 881540)

This paper examines the requirements for the flight crew displays for Space Station proximity operations (i.e., operations within a range of 1 km from the Station), such as the control of manned and unmanned vehicles and robotics devices, final rendezvous and approach, berthing and docking, and separation and departure from the Station. Particular attention is given to the impact of the display device selection on the configuration of the Space Station cupolas. It is shown that, compared to CRTs, the flat-panel displays save over 450 lb of weight. The available state-of-the-art display technology is reviewed, and data are presented for a comparison of CRTs and active matrix LCD displays, as well as for various flat-panel technologies. I.S.

N89-25570# Oak Ridge National Lab., TN. Center for Engineering Systems Advanced Research.
REVIEW OF THE 1988 WORKSHOP ON HUMAN-MACHINE SYMBIOTIC SYSTEMS
LYNNE E. PARKER and CHARLES R. WEISBIN 1989 5 p Presented at the Workshop on Integration of AI and Robotic Systems, Scottsdale, AZ, 19 May 1989
(Contract DE-AC05-84OR-21400)
(DE89-008743; CONF-8905109-1; CESAR-89/14) Avail: NTIS HC A02/MF A01

This report presents a review of the 1988 Workshop on Human-Machine Symbiotic Systems. Held December 5 to 6, 1988 in Oak Ridge, Tennessee, the workshop served as a forum for the discussion of several critical issues in human-machine symbiosis: human-machine communication, autonomous task planning and execution monitoring for heterogeneous agents, dynamic task allocation, human-machine system architecture, and machine learning via experience and human observation. The presentation of overview papers by invited keynote speakers provided a background for the breakout session discussions in these five areas. A summary of the conclusions and recommendations for future work resulting from the workshop is reported. DOE

N89-25571# Oak Ridge National Lab., TN. Cognitive Science and Human Factors Group.
OPERATOR ROLE DEFINITION AND HUMAN SYSTEM INTEGRATION
H. E. KNEE and J. C. SCHRYVER 1989 21 p Presented at the 7th Power Plant Dynamics, Control and Testing Symposium, Knoxville, TN, 15 May 1989
(Contract DE-AC05-84OR-21400)
(DE89-009621; CONF-890555-8) Avail: NTIS HC A03/MF A01

This paper discusses operator role definition and human-system integration from a perspective of systems engineering and allocation of functions. Current and traditional allocation of tasks/functions can no longer be applied to systems that are significantly more sophisticated and dynamic than current system designs. For such advanced and automated designs, explicit attention must be given to the role of the operator in order to facilitate efficient system performance. Furthermore, such systems will include intelligent automated systems which will support the cognitive activities of the operator. If such systems share responsibility and control with the human operator, these computer-based assistants/associates should be viewed as intelligent team members. As such, factors such as trust, intentions, and expectancies, among team members must be considered by the systems designer. Such design considerations are discussed in this paper. This paper also discusses the area of dynamic allocation of functions, and the need for models of the human operator in support of machine forecast of human performance. The Integrated Reactor Operator/System (INTEROPS) model is discussed as an example of a cognitive model capable of functioning beyond a rule-based behavioral structure. DOE

N89-25572# Oak Ridge National Lab., TN. Center for Engineering Systems Advanced Research.
THE 1988 WORKSHOP ON HUMAN-MACHINE SYMBIOTIC SYSTEMS
L. E. PARKER and *CHARLES R. WEISBIN 1988* 6 p Workshop held in Oak Ridge, TN, 5-6 Dec. 1988 Submitted for publication
(Contract DE-AC05-84OR-21400)
(DE89-010170; CONF-881281) Avail: NTIS HC A02/MF A01

This report presents the proceedings of the 1988 Workshop on Human-Machine Symbiotic Systems. Held December 5 to 6, 1988 in Oak Ridge, Tennessee, the workshop served as a forum for the discussion of several critical issues in human-machine symbiosis: human-machine communication, autonomous task planning and execution monitoring for heterogeneous agents, dynamic task allocation, human-machine system architecture, and machine learning via experience and human observation. DOE

N89-25573*# Purdue Univ., West Lafayette, IN. Dept. of Psychological Sciences.
TIMESHARING PERFORMANCE AS AN INDICATOR OF PILOT MENTAL WORKLOAD Final Report
PATRICIA A. CASPER, BARRY H. KANTOWITZ, and ROBERT D. SORKIN 1988 31 p
(Contract NCC2-349)
(NASA-CR-185328; NAS 1.26:185328) Avail: NTIS HC A03/MF A01 CSCL 05/8

Attentional deficits (workloads) were evaluated in a timesharing task. The results from this and other experiments were incorporated into an expert system designed to provide workload metric selection advice to non-experts in the field interested in operator workload. B.G.

N89-25574# Imperial Coll. of Science and Technology, London (England). Dept. of Computing.
THE MAN-MACHINE-INTERFACE IN A FAST JET M.S. Thesis
A. C. PEARCE Sep. 1988 169 p
(ETN-89-94327) Avail: NTIS HC A08/MF A01

Limitations of the traditional methods of presenting information to pilots in high performance aircraft are discussed. It is shown how modern technology can improve this information interchange using electronic and head up displays. The role of speech recognition and speech synthesis is covered. The super cockpit project and the advantages this should bring are considered. ESA

N89-25575# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abteilung Anthropotechnik und Simulation.
VALIDATION OF THE SUBJECTIVE WORKLOAD ASSESSMENT TECHNIQUE IN A SIMULATED FLIGHT TASK
FRED V. SCHICK, UWE TEEGEN, RAINER UCKERMANN, and REUBEN L. HANN (Air Force Medical Center, Wright-Patterson AFB, OH.) 16 Dec. 1988 75 p
(DFVLR-FB-89-01; ISSN-0171-1342; ETN-89-94642) Avail: NTIS HC A04/MF A01; DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, DM 26.50

A German language version of the Subjective Workload Assessment Technique (SWAT) for the assessment of mental workload was developed. After the German SWAT scale was found equivalent to the original, its validity was investigated in an experiment with 14 pilots in a flight simulator. Variations of SWAT scores in accordance with variations in task demand were analyzed in comparison with physiological and behavioral measures. The German SWAT is found to be a valid tool for the detection of workload differences given in the subsegments of a flight mission. The SWAT differentiates significantly and more consistently over the whole range of the applied workload levels than electrocardiographic and electromyographic parameters and a combined measure of pilot input activity. ESA

N89-26391*# Research Inst. for Advanced Computer Science, Moffett Field, CA.
HUMAN FACTORS WORKPLACE CONSIDERATIONS
RICHARD F. HAINES Oct. 1988 23 p
(Contract NASW-4234)
(NASA-CR-185400; NAS 1.26:185400; RIACS-TR-88.36) Avail: NTIS HC A03/MF A01 CSCL 05/8

Computer workstations assume many different forms and play different functions today. In order for them to assume the effective interface role which they should play they must be properly designed to take into account the ubiguitous human factor. In addition, the entire workplace in which they are used should be properly configured so as to enhance the operational features of the individual workstation where possible. A number of general human factors workplace considerations are presented. This ongoing series of notes covers such topics as achieving comfort and good screen visibility, hardware issues (e.g., mouse maintenance), screen symbology features (e.g., labels, cursors, prompts), and various miscellaneous subjects. These notes are presented here in order to: (1) illustrate how one's workstation can be used to support telescience activities of many other people working within an organization, and (2) provide a single complete set of considerations for future reference. Author

N89-26392*# Behavioral Health Systems, Inc., Ossining, NY.
VOICE MEASURES OF WORKLOAD IN THE ADVANCED FLIGHT DECK Final Report
SID J. SCHNEIDER, MURRAY ALPERT, and RICHARD ODONNELL Washington Aug. 1989 70 p
(Contract NAS1-18278)
(NASA-CR-4249; NAS 1.26:4249) Avail: NTIS HC A04/MF A01 CSCL 05/8

Voice samples were obtained from 14 male subjects under high and low workload conditions. Acoustical analysis of the voice suggested that high workload conditions can be revealed by their effects on the voice over time. Aircrews in the advanced flight deck will be voicing short, imperative sentences repeatedly. A drop in the energy of the voice, as reflected by reductions in amplitude and frequency over time, and the failure to achieve old amplitude and frequency levels after rest periods, can signal that the workload demands of the situation are straining the speaker. This kind of measurement would be relatively unaffected by individual differences in acoustical measures. Author

N89-26393*# ST Systems Corp., Lanham, MD.
IMPEDANCE HAND CONTROLLERS FOR INCREASING EFFICIENCY IN TELEOPERATIONS
CRAIG CARIGNAN and JANICE TARRANT 1989 10 p
Presented at the 1989 NASA Conference on Space Telerobotics, Pasadena, CA
(Contract NAS5-28561)
(NASA-CR-183431; NAS 1.26:183431) Avail: NTIS HC A02/MF A01 CSCL 05/8

An impedance hand controller with direct force feedback is examined as an alternative to bilateral force reflection in teleoperations involving force contact. Experimentation revealed an operator preference for direct force feedback which provided a better feel of contact with the environment. The advantages of variable arm impedance were also made clear in tracking tests where subjects preferred the larger hand controller inertias made possible by the acceleration feedback loop in the master arm. The ability to decouple the hand controller impedance from the slave arm dynamics is expected to be even more significant when the inertial properties of various payloads in the slave arm are considered. Author

N89-26394# Systems Research Labs., Inc., Dayton, OH.
DEMONSTRATION OF PHYSIOLOGICAL WORKLOAD CORRELATES IN CREW CAPABILITY SIMULATION Interim Report, Nov. 1987 - Dec. 1988
KATHY MCCLOSKEY, MELODIE MORROW, and WILLIAM A. PEREZ 3 Jan. 1989 71 p
(Contract F33615-85-C-0541)
(AD-A206824; AAMRL-TR-89-002) Avail: NTIS HC A04/MF A01 CSCL 05/8

A laboratory physiological measurement device was modified for use in part-mission, multicrew main-in-the-loop simulation experiments. An abstract flight simulation task was employed to obtain behavioral and physiological measures (heart rate, eyeblink, and evoke potentials) which were correlated to achieve an understanding of crew workload. The two classes of workload measures were shown to be relatable and complementary. The modified Neurophysiological Workload Test Battery device was demonstrated to be suitable for use in long duration, manned simulation experiment. GRA

N89-26395# Naval Ocean Systems Center, San Diego, CA.
TELETOUCH DISPLAY DEVELOPMENT, PHASE 1 Final Report, Oct. - Dec. 1987
STEVEN F. WIKER Jul. 1988 66 p
(AD-A206919; NOSC/TR-1230) Avail: NTIS HC A04/MF A01 CSCL 12/9

Teleoperated manipulators currently in use rely mainly upon visual feedback to accomplish simple manipulation tasks. In some cases, to enhance manipulative capabilities, force reflection and positional correspondence are provided between slave manipulator and master controller arms, along with simple end-effector proximity and slip sensors. However, as noted by Bejczy, space-station assembly, satellite servicing in orbit, extraplanetary exploration, and undersea operations (which require only seemingly ordinary manipulative capabilities) can overwhelm present teleoperated capabilities. To extend telemanipulative capabilities and applications, proposals have been made to improve the quality of current visual, proprioceptive, and kinesthetic feedback. Yet, without feeding back end-effector surface contact phenomena to the teleoperator, remote systems are difficult to field that possess a high degree of dextrous manipulative and haptic abilities. This report reviews human-tactual capabilities and previous efforts in tactile-display development, and recommends approaches for developing teletouch display systems for telerobotic systems. GRA

N89-26396# Navy Clothing and Textile Research Facility, Natick, MA.
EFFECTIVENESS OF THREE PORTABLE COOLING SYSTEMS IN REDUCING HEAT STRESS Final Technical Report, Feb. - Aug. 1988
NANCY A. PIMENTAL and BARBARA A. AVELLINI Mar. 1989 19 p
(AD-A206959; NCTRF-176) Avail: NTIS HC A03/MF A01 CSCL 05/8

The Navy Clothing & Textile Research Facility (NCTRF) conducted a laboratory evaluation to examine a battery-operated, circulating liquid cooling vest and two passive, frozen gel pack vests for their effectiveness in reducing heat strain. The battery-operated system was the Model 1905 Cool Vest, manufactured by ILC Dover, Inc. (ILC). The passive systems were the SteeleVest, manufactured by Steele, Inc. (STEELE), and the Stay Cool Vest, manufactured by American Vest Co. (AMERICAN). Eight test subjects attempted four heat exposures, one without cooling (CONTROL) and one with each of the three cooling systems. The ILC and the STEELE, were similarly effective in reducing heat strain. The AMERICAN, reduced rectal temperature compared with the CONTROL, but not skin temperature, heart rate or sweat rate. The AMERICAN was not nearly as effective as the other two systems, possibly because of its lower surface area available for cooling and poor contact between the torso and the gel packs. Each of the cooling systems has logistical concerns. The ILC requires battery storage and recharging. The STEELE, however, requires more freezer space than the ILC for its coolant. If the added freezer space is not a limiting factor, the STEELE system, because of its simplicity, ease of use and low profile, is recommended for shipboard use. GRA

N89-26397# Naval Submarine Medical Research Lab., Groton, CT.

MODULATION-RATE PERCEPTION: IDENTIFICATION AND DISCRIMINATION OF MODULATION RATE USING A NOISE CARRIER Technical Report, Oct. 1987 - Oct. 1988

THOMAS E. HANNA 30 Jan. 1989 24 p

(AD-A207078; NSMRL-1128) Avail: NTIS HC A03/MF A01 CSCL 05/8

Modulation-rate thresholds were measured for three tasks: a fixed-standard, forced-choice discrimination task with a 500-ms interstimulus interval; a random-standard, forced-choice discrimination task with an 8-sec interstimulus interval; and an identification task. Thresholds were obtained for modulation rates from 14 to 224 Hz with noise carriers band-pass filtered from 500 to 4000 Hz, 500 to 1600 Hz, 1700 to 2800 Hz, and 2900 to 4000 Hz. The four bands yielded similar results except for modulation rates of 150 Hz and greater, where the 500 to 1600 Hz thresholds were higher. Fixed-standard discrimination thresholds were a relatively constant 3 Hz for modulation rates up to 66 Hz. The increase of thresholds for modulation rates above 66 Hz could be due to temporal resolution limits with a time constant of about 2.4 msec. For modulation rates above 100 Hz, critical-band filtering decreases sensitivity to modulation rate for the 500 to 1600 Hz noise band. Resolution in the random-standard discrimination task was similar to that for the identification task. Thresholds were elevated relative to fixed-standard thresholds except at the edges of the stimulus range. In the random-standard discrimination task, a pronounced criterion bias was present for stimuli near the edge of the range. Durlach & Braida's (1969) model describes the data well and provides quantitative measures in good agreement with those for intensity perception. GRA

N89-26398*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

RESULTS AND APPLICATIONS OF A SPACE SUIT RANGE-OF-MOTION STUDY

AL REINHARDT Jul. 1989 16 p Presented at the SAE Intersociety Conference on Environmental Systems, Moffett Field, CA, 24-27 Jul. 1989

(NASA-TM-102204; A-89164; NAS 1.15:102204) Avail: NTIS HC A03/MF A01 CSCL 05/8

The range of motion of space suits has traditionally been described using limited 2-D mapping of limb, torso, or arm movements performed in front of an orthogonal grid. A new technique for recovering extra-vehicular (EVA) space suit range-of-motion data during underwater testing was described in a paper presented by the author at the 1988 conference. The new technique uses digitized data which is automatically acquired from video images of the subject. Three-dimensional trajectories are recovered from these data, and can be displayed using 2-D computer graphics. Results of using this technique for the current shuttle EVA suit during underwater simulated weightlessness testing are discussed. Application of the data for use in animating anthropometric computer models is highlighted. Author

N89-26532*# Massachusetts Inst. of Tech., Cambridge.

ISSUES IN HUMAN/COMPUTER CONTROL OF DEXTEROUS REMOTE HANDS

K. SALISBURY *In* Jet Propulsion Lab., California Inst. of Tech., Proceedings of the Workshop on Space Telerobotics, Volume 2 p 351-360 1 Jul. 1987

Avail: NTIS HC A18/MF A01 CSCL 05/8

Much research on dexterous robot hands has been aimed at the design and control problems associated with their autonomous operation, while relatively little research has addressed the problem of direct human control. It is likely that these two modes can be combined in a complementary manner yielding more capability than either alone could provide. While many of the issues in mixed computer/human control of dexterous hands parallel those found in supervisory control of traditional remote manipulators, the unique geometry and capabilities of dexterous hands pose many new problems. Among these are the control of redundant degrees of freedom, grasp stabilization and specification of non-anthropomorphic behavior. An overview is given of progress made at the MIT AI Laboratory in control of the Salisbury 3 finger hand, including experiments in grasp planning and manipulation via controlled slip. It is also suggested how we might introduce human control into the process at a variety of functional levels. Author

N89-26533*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

MAN-MACHINE INTERFACE ISSUES IN SPACE TELEROBOTICS: A JPL RESEARCH AND DEVELOPMENT PROGRAM

A. K. BEJCZY *In its* Proceedings of the Workshop on Space Telerobotics, Volume 2 p 361-369 1 Jul. 1987

Avail: NTIS HC A18/MF A01 CSCL 05/8

Technology issues related to the use of robots as man-extension or telerobot systems in space are discussed and exemplified. General considerations are presentd on control and information problems in space teleoperation and on the characteristics of Earth orbital teleoperation. The JPL R and D work in the area of man-machine interface devices and techniques for sensing and computer-based control is briefly summarized. The thrust of this R and D effort is to render space teleoperation efficient and safe through the use of devices and techniques which will permit integrated and task-level (intelligent) two-way control communication between human operator and telerobot machine in Earth orbit. Specific control and information display devices and techniques are discussed and exemplified with development results obtained at JPL in recent years. Author

N89-26540*# Stanford Univ., CA.

REPORT ON THE STANFORD/AMES DIRECT-LINK SPACE SUIT PREHENSOR

J. W. JAMESON and LARRY LEIFER *In* Jet Propulsion Lab., California Inst. of Tech., Proceedings of the Workshop on Space Telerobotics, Volume 2 p 433-442 1 Jul. 1987 Sponsored by NASA. Ames Research Center

Avail: NTIS HC A18/MF A01 CSCL 05/8

Researchers at the Center for Design Research at Stanford University, in collaboration with NASA Ames at Moffet Field, California, are developing hand-powered mechanical prehensors to replace gloves for EVA spacesuits. The design and functional properties of the first version Direct Link Prehensor (DLP) is discussed. It has a total of six degrees-of-freedom and is the most elaborate of three prehensors being developed for the project. The DLP has a robust design and utilizes only linkages and revolute joints for the drive system. With its anthropomorphic configuration of two fingers and a thumb, it is easy to control and is capable of all of the basic prehension patterns such as cylindrical or lateral pinch grasps. Kinematic analysis reveals that, assuming point

contacts, a grasped object can be manipulated with three degrees-of-freedom. Yet, in practice more degrees-of-freedom are possible. Author

55

SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A89-44166
BIOLOGIC VERSUS ABIOTIC MODELS OF COMETARY GRAINS
M. K. WALLIS, N. C. WICKRAMASINGHE, F. HOYLE, and R. RABILIZIROV (Cardiff, University College, Wales) Royal Astronomical Society, Monthly Notices (ISSN 0035-8711), vol. 238, June 1, 1989, p. 1165-1170. refs

The infrared spectral feature around 3.4 microns observed in Comet Halley is indicative of organic material, as shown to lowest order by transmission layer calculations. The detailed profile of the waveband emitted by grains of dust depends, however, on their sizes and temperatures. Radiatively processed methane-ice shows a 3.4-micron feature, as would be expected. But, contrary to a previous claim for the 'tholin' model, this differs significantly from the observed spectrum. New calculations for a size-distribution of realistic grains of biotic material give quite a close fit, confirming that this is a good candidate for the complex organic material detected by the Comet Halley probes. Author

A89-44489
LIFE SCIENCES AND SPACE RESEARCH XXIII(1): EXOBIOLOGY SCIENCE AND PRIMITIVE SOLAR SYSTEM BODIES; PROCEEDINGS OF WORKSHOP XXII OF THE 27TH COSPAR PLENARY MEETING, ESPOO, FINLAND, JULY 18-29, 1988
J. ORO, ED. (Houston, University, Texas) Meeting Sponsored by COSPAR. Advances in Space Research (ISSN 0273-1177), vol. 9, no. 2, 1989, 127 p. For individual items see A89-44490 to A89-44505.

Papers on exobiology and primitive solar system bodies are presented, covering topics such as observational astrochemistry, interstellar dust as a source of organic molecules in Comet Halley, the origin of the P/Halley dust component, polymeric organic molecules in Comet Hally, organic ions in the atmosphere of Comet Halley, and organic solids produced from C/H/O/N ices by carged particles. Other topics include cometary organics and the 3.4-micron spectral feature, organic compounds in carbonaceous chondrites, macromolecular carbon compounds on the dark surfaces of asteroids and comets, results concerning Titan, a possible ocean on Europa, comets as a source of preformed material for prebiotic evolution, and the Gas-Grain Simulation Facility on the Space Station. In addition, consideration is given to the origin of precursors of organic molecules during evaporation of meteorites and rocks, the origin of organics on clays, and chemical evolution of primitive solar system bodies. R.B.

A89-44496
COMETARY ORGANICS AND THE 3.4-MICRON SPECTRAL FEATURE
M. K. WALLIS, N. C. WICKRAMASINGHE, F. HOYLE, and R. RABILIZIROV (Carfdiff, University College, Wales) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 2, 1989, p. 55-58. refs

The IR spectral feature near 3.4 microns in Comet Halley is compared to the 3.4-micron feature of radiatively-processed methane ice. It is shown that a realistic model which fits the two features may be obtained when the abiotic tholin is taken in the form of separate grains with size distributions similar to those detected by the Halley probes and with temperatures derived by Mie calculations for spherical grains of biotic material. R.B.

A89-44500
PROSPECTS FOR THE EXISTENCE AND DETECTABILITY OF AN OCEAN ON EUROPA
S. W. SQUYRES (Cornell University, Ithaca, NY) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 2, 1989, p. 79-85. refs

The possibile existence of liquid water within Europa is examined. The possibility that tidal energy dissipation may serve as the heat source which maintains the liquid water is discussed. Images of Europa taken by Voyager are considered. Models to explain the internal structure of Europa, which are consistent with the surface composition and density of the satellite are outlined, focusing on the ice/ocean model. Also, a technique using radar sounding as a means to detect an ocean on Europa is described. R.B.

A89-44502* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MICROGRAVITY PARTICLE RESEARCH ON THE SPACE STATION - THE GAS-GRAIN SIMULATION FACILITY
G. FOGLEMAN, J. L. HUNTINGTON, G. C. CARLE (NASA, Ames Research Center, Moffett Field, CA), and J. A. NUTH (NASA, Goddard Space Flight Center, Greenbelt, MD) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 2, 1989, p. 91-94. refs

In the gravitational field on earth, the large settling rate of micron-sized particles and the effects of gravity-induced convection prohibit many interesting studies of phenomena such as coagulation, collisions, and mutual interactions of droplets, dust grains and other particles. Examples of exobiology experiments involving these phenomena are the simulation of organic aerosol formation in Titan's atmosphere, studies of the role of comets in prebiotic chemical evolution, and simulations of carbon grain interactions in various astrophysical environments. The Gas-Grain Simulation Facility (GGSF) is a proposed earth-orbital laboratory that will allow present ground-based experimental programs which study processes involving small particles and weak interactions to be extended to a new domain. Physics issues that scientists wishing to propose GGSF experiments must consider are reviewed in this paper. Specifically, coagulation, motion in gases and vacua, and wall deposition of particles in a microgravity environment are discussed. Author

A89-44504
THE UNIVERSE AND THE ORIGIN OF LIFE ON THE EARTH (ORIGIN OF ORGANICS ON CLAYS)
V. I. MARON (Moskovskii Institut Neftekhimicheskoi i Gazovoi Promyshlennosti, Moscow, USSR) and M. D. NUSSINOV Advances in Space Research (ISSN 0273-1177), vol. 9, no. 2, 1989, p. 99-103. refs

The transition from the chemical stage of matter evolution in the universe and the biological stage of matter evolution on earth is examined. A model of the noncelled phase of abiogenesis is developed, taking into account the characteristics of the intermediate transitional material as a base for the transition. The role of clayish materials in meteoroids as in situ formation catalysts of organic polymers is discussed. The conditions for the formation of primitive nucleoproteinaceous complexes, nucleic acids, and short peptides are considered. R.B.

A89-44505* Houston Univ., TX.
CHEMICAL EVOLUTION OF PRIMITIVE SOLAR SYSTEM BODIES
J. ORO and T. MILLS (Houston, University, TX) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 2, 1989, p. 105-120. refs
(Contract NGR-44-005-002)

Observations on organic molecules and compounds containing biogenic elements in the interstellar medium and in the primitive bodies of the solar system are reviewed. The discovery of phosphorus molecular species in dense interstellar clouds, the existence of organic ions in the dust and gas phase of the comas of Comet Halley, and the presence of presolar, deuterium-hydrogen ratios in the amino acids of carbonaceous chondrites are discussed.

The relationships between comets, dark asteroids, and carbonaceous chondrites are examined. Also, consideration is given to the chemical evolution of Titan, the primitive earth, and early Mars. R.B.

A89-44736
MIRROR SYMMETRY BREAKDOWN IN A CHIRAL SYSTEM WITH TWO ORDER PARAMETERS [NARUSHENIE ZERKAL'NOI SIMMETRII V KHIRAL'NOI KHIMICHESKOI SISTEME S DVUMIA PARAMETRAMI PORIADKA]
S. A. ANIKIN and A. E. ARINSHTEIN (AN SSSR, Institut Khimicheskoi Fiziki, Moscow, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 305, no. 4, 1989, p. 884-887. In Russian. refs

An example of a chiral system is presented which is based on the symmetry breakdown model proposed by Frank (1953) in which the asymmetrical mode can be formed by either the soft or the hard mechanism. The principal feature of the model presented here is that it has two order parameters. It is shown that the expanded class of reactions in the system significantly changes the system properties. V.L.

A89-45182
TOTAL SYNTHESIS OF AMINO ACIDS IN HIGH VACUUM [SYNTHESE TOTALE DES AMINO-ACIDES DANS UN VIDE ELEVE]
F. MARCEL DEVIENNE and JANINE GOUDOUR (Laboratoire de Physique Moleculaire des Hautes Energies, Peymeinade, France) Academie des Sciences (Paris), Comptes Rendus, Serie II - Mecanique, Physique, Chimie, Sciences de l'Univers, Sciences de la Terre (ISSN 0249-6305), vol. 308, no. 16, April 20, 1989, p. 1419-1422. In French. refs

The total synthesis of 16 amino acids has been performed by bombarding pure graphite by high-energy (13 keV) molecular beams of N2, H2, and O2 in high vacuum. The molecular beams have densities of 10 to the 12 molecules/s to 3 x 10 to the 14th molecules/s. The synthesis of each of the amino acids has been confirmed by mass-spectrum identification and by analysis of the mass spectra of the amino acid fragments. It is suggested that these amino acids may have been formed either on the outside or on the inside of the graphite layers. R.R.

A89-45264*# Chicago Univ., IL.
EARLY ENVIRONMENTAL EFFECTS OF THE TERMINAL CRETACEOUS IMPACT
IAIN GILMOUR, WENDY S. WOLBACH, and EDWARD ANDERS (Chicago, University, IL) Lunar and Planetary Institute, Global Catastrophes in Earth History - An Interdisciplinary Conference on Impacts, Volcanism and Mass Mortality, Snowbird, UT, Oct. 20-23, 1988, Paper. 20 p. refs
(Contract NSF EAR-86-09218; NAG9-52)

The environmental aftereffects of the terminal Cretaceous impact are examined on the basis of the carbon and nitrogen geochemistry in the basal layer of the K-T boundary clay at Woodside Creek, New Zealand. It is shown that organic carbon and nitrogen at this level are enriched by 15 and 20 times Cretaceous values, respectively. Also, it is found that the N abundances and, to a lesser extent, the organic C abundances are closely correlated with the Ir abundances. The changes in carbon and nitrogen content through the basal layer are outlined, focusing on the possible environmental conditions which could have caused enrichment. In addition, consideration is given to the soot and pyrotoxin content. Possible scenarios for the K-T event and the importance of selective extinction are discussed. R.B.

A89-46583
ORGANIC MATERIALS IN A MARTIAN METEORITE
I. P. WRIGHT, M. M. GRADY, and C. T. PILLINGER (Open University, Milton Keynes, England) Nature (ISSN 0028-0836), vol. 340, July 20, 1989, p. 220-222. Research supported by SERC. refs

The meteorite EETA 79001, which many believe to have originated on Mars, contains carbonate minerals thought to be Martian weathering or alteration products. Accompanying the carbonates are unexpectedly high concentrations of organic materials. Although the carbon isotope composition of these materials is indistinguishable from terrestrial biogenic components, and so cannot be used to assess the source, it is argued here that their occurrence in an interior sample of a clean Antarctic meteorite militates against a wholly terrestrial origin. A sample of Martian organic materials may thus be available for further study in the laboratory. Author

N89-26336*# Hebrew Univ., Jerusalem (Israel). Dept. of Soil and Water Science.
VIKING BIOLOGY EXPERIMENTS AND THE MARTIAN SOIL Abstract Only
AMOS BANIN *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 6 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 03/2

The Viking Biology Experiments (VBE) are the most informative database on the wet chemistry and reactivity of the Martian soil available today. The simulation and chemical interpretation of the results have given valuable hints towards the characterization of the soils' mineralogy, adsorption properties, pH and redox. The characterization of Mars' soil on the basis of ten years of labelled release (LR) and other VBE simulations are reviewed. Author

N89-26337*# Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia). Div. of Continental Geology.
MICROBIAL MATS IN PLAYA LAKES AND OTHER SALINE HABITATS: EARLY MARS ANALOG? Abstract Only
JOHN BAULD *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 7-8 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 03/2

Microbial mats are cohesive benthic microbial communities which inhabit various Terra (Earth-based) environments including the marine littoral and both permanent and ephemeral (playa) saline lakes. Certain geomorphological features of Mars, such as the Margaritifer Sinus, were interpreted as ancient, dried playa lakes, presumably formed before or during the transition to the present Mars climate. Studies of modern Terran examples suggest that microbial mats on early Mars would have had the capacity to survive and propagate under environmental constraints that would have included irregularly fluctuating regimes of water activity and high ultraviolet flux. Assuming that such microbial communities did indeed inhabit early Mars, their detection during the Mars Rover Sample Return (MRSR) mission depends upon the presence of features diagnostic of the prior existence of these communities or their component microbes or, as an aid to choosing suitable landing, local exploration or sampling sites, geomorphological, sedimentological or chemical features characteristic of their playa lake habitats. Examination of modern Terran playas (e.g., the Lake Eyre basin) shows that these features span several orders of magnitude in size. While stromatolites are commonly centimeter-meter scale features, bioherms or fields of individuals may extend to larger scales. Preservation of organic matter (mats and microbes) would be favored in topographic lows such as channels or ponds of high salinity, particularly those receiving silica-rich groundwaters. These areas are likely to be located near former zones of groundwater emergence and/or where flood channels entered the paleo-playa. Fossil playa systems which may aid in assessing the applicability of this particular Mars analog include the Cambrian Observatory Hill Beds of the Officer Basin and the Eocene Wilkins Peak Member of the Green River Formation. Author

N89-26366*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
VIKING AND MARS ROVER EXOBIOLOGY Abstract Only
D. E. SCHWARTZ, ROCCO L. MANCINELLI, and B. J. OHARA *In its* Exobiology and Future Mars Missions p 54 Mar. 1989
Avail: NTIS HC A04/MF A01 CSCL 06/3

Other than Earth, Mars is the planet generating the greatest interest among those researching and contemplating the origin and distribution of life throughout the universe. The similarity of

the early environments of Earth and Mars, and the biological evolution on early Earth provides the motivation to seriously consider the possibility of a primordial Martian biosphere. In 1975 the Viking project launched two unmanned spacecraft to Mars with the intent of finding evidence of the existence of present or past life on this planet. Three Viking Biology experiments were employed: the Labeled Release experiment, the Gas Exchange Experiment, and the Pyrolytic Release experiment. Each of these three experiments tested for microbial existence and utilization of a substrate by examining the gases evolved from specific chemical reactions. Although the results of these experiments were inconclusive, they inferred that there are no traces of extant life on Mars. However, the experiments did not specifically look for indication of extinct life. Therefore, most of the exobiologic strategies and experiments suggested for the Mars Rover Sample Return Mission involve searching for signature of extinct life. The most significant biological signatures and chemical traces to detect include: isotopic and chemical signatures of metabolic activity, anomalous concentrations of certain metals, trace and microfossils, organically preserved materials, carbonates, nitrates, and evaporites. Author

N89-26367*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

MARS ROVER SAMPLE RETURN: A SAMPLE COLLECTION AND ANALYSIS STRATEGY FOR EXOBIOLOGY Abstract Only

M. H. SIMS, M. FISCHLER, D. E. SCHWARTZ, DONALD A. ROSENTHAL, ROCCO L. MANCINELLI, SUSAN S. NEDELL, E. GAMBLE, and CHRISTOPHER P. MCKAY *In its* Exobiology and Future Mars Missions p 55 Mar. 1989

Avail: NTIS HC A04/MF A01 CSCL 06/3

For reasons defined elsewhere it is reasonable to search for biological signatures, both chemical and morphological, of extinct life on Mars. Life on Earth requries the presence of liquid water, therefore, it is important to explore sites on Mars where standing bodies of water may have once existed. Outcrops of layered deposits within the Valles Marineris appear to be ancient lake beds. Because the outcrops are well exposed, relatively shallow core samples would be very informative. The most important biological signature to detect would be organics, microfossils, or larger stromato-like structures, although the presence of cherts, carbonates, clays, and shales would be significant. In spite of the limitations of current robotics and pattern recognition, and the limitations of rover power, computation, Earth communication bandwidth, and time delays, a partial scenario was developed to implement such a scientific investigation. The rover instrumentation and the procedures and decisions and IR spectrometer are described in detail. Preliminary results from a collaborative effort are described, which indicate the rover will be able to autonomously detect stratification, and hence will ease the interpretation burden and lead to greater scientific productivity during the rover's lifetime. A.D.

N89-26368*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ELECTRON SPIN RESONANCE (ESR) DETECTION OF ACTIVE OXYGEN SPECIES AND ORGANIC PHASES IN MARTIAN SOILS

FUN-DOW TSAY, SOON SAM KIM, and RANTY H. LIANG *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 56-58 Mar. 1989

Avail: NTIS HC A04/MF A01 CSCL 06/3

The presence of active oxygen species (O(-), O2(-), O3(-)) and other strong oxidants (Fe2O3 and Fe3O4) was invoked in interpretations of the Viking biological experiments and a model was also suggested for Martian surface chemistry. The non-biological interpretations of the biological results gain futher support as no organic compounds were detected in the Viking pyrolysis-gas chromatography mass spectrometer (GCSM) experiments at concentrations as low as 10 ppb. Electron spin resonance (ESR) measures the absorption of microwaves by a paramagnetic and/or ferromagnetic center in the presence of an external field. In many instances, ESR has the advantage of detailed submicroscopic identification of the transient species and/or unstable reaction intermediates in their environments. Since the higly active oxygen species (O(-), O2(-), O3(-), and R-O-O(-)) are all paramagnetic in nature, they can be readily detected in native form by the ESR method. Active oxygen species likely to occur in the Martian surface samples were detected by ESR in UV-irradiated samples containing MgO. A miniaturized ESR spectrometer system can be developed for the Mars Rover Sample Return Mission. The instrument can perform the following in situ Martian samples analyses: detection of active oxygen species; characterization of Martian surface chemistry and photooxidation processes; and searching for organic compounds in the form of free radicals preserved in subsoils, and detection of microfossils with Martian carbonate sediments. Author

N89-26370*# Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).

FOSSIL LIFE ON MARS

M. R. WALTER *In* NASA, Ames Research Center, Exobiology and Future Mars Missions p 60-61 Mar. 1989

Avail: NTIS HC A04/MF A01 CSCL 06/3

Three major problems beset paleontologists searching for morphological evidence of life on early Earth: selecting a prospective site; finding biogenic structures; and distinguishing biogenic from abiogenic structures. The same problems arise on Mars. Terrestrial experience suggests that, with the techniques that can be employed remotely, ancient springs, including hot springs, are more prospective than lake deposits. If, on the other hand, the search is for chemical evidence, the strategy can be very different, and lake deposits are attractive targets. Lakes and springs frequenly occur in close proximity, and therefore a strategy that combines the two would seem to maximize the chance of success. The strategy for a search for stromatolite on Mars is discussed. Author

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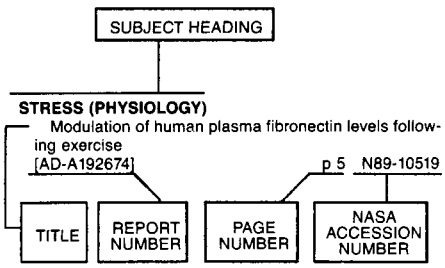

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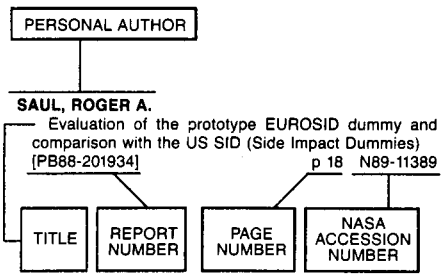

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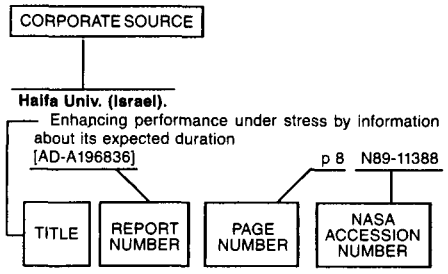

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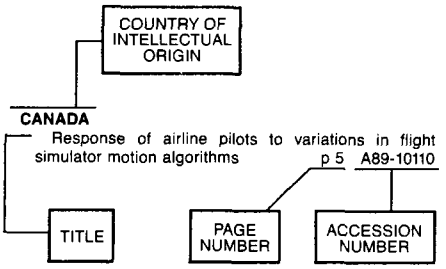

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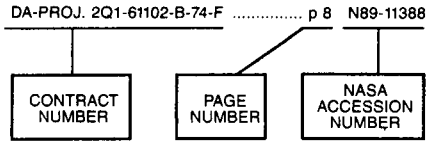

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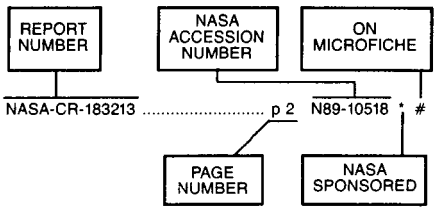

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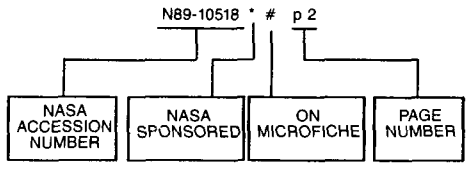

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